Multiple Case Study to Describe Influencing Factors on Effectiveness of an Interdisciplinary In-Patient Intervention for Feeding Problems in Children

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Abstract

In children with chronic feeding problems, diagnoses and physical, cognitive and behavioral impairments vary enormously. In addition to these variables, we hypothesize that personal and environmental factors also contribute to the success of interventions for feeding problems. This exploratory study describes the effectiveness and influencing factors of an intensive, multidisciplinary child and parent-centered intervention on calorie intake and solid food consumption.

The intervention included a behavioral program, oral motor training, parental coaching and dietary support. The children participating in the intervention could be separated into three groups: tube-fed (n=12), selective food refusal by texture (n=6) and unpredictable food refusal (n=11). For each group we present a descriptive representative case study. Outcome measures were calorie intake and amount of solid food consumed.

The average duration of the in-patient feeding intervention was 4.3 weeks (SD 1.4 weeks). Three months after discharge, 50% of the children receiving tube feeding had complete oral intake. Children with selective food refusal by texture made small progresses during the intervention but solid food intake had increased at follow-up. Children with unpredictable food refusal increased their oral intake during the intervention and maintained these gains at home.

The intensive interdisciplinary intervention showed increased calorie and oral intake in most children and reduced tube feeding, but was less successful in children with metabolic dysfunction. Recovery time was longest in the tube feeding group but results varied considerably per child. Successful feeding intervention in children needs to take into account a child's underlying physical and behavioral and environmental factors.

Keywords: Children; Feeding problems; Interdisciplinary intervention; Nutrition; In-patient program; Family centered program

Introduction

The clinical manifestation of feeding problems in children varies from selective food refusal to dysphagia [1-4]. With an incidence of 25 to 35 percent, minor feeding problems are common in early childhood for otherwise healthy children; for children with chronic medical problems, however, the incidence is 40 to 80 percent [5,6]. The impact of feeding problems on a child's health ranges from mild to considerable and the relationship between food consumption and long-term health outcomes has become increasingly evident. Early feeding experiences are related to dietary preferences in later life and modulate intake and nutritional status [7-10].

Authors suggest an interaction between oral motor factors, behavioral issues and environmental factors [11-13]. A child's refusal to eat results in inadequate development of oral motor skills (e.g. chewing) and this prevents the child from advancing to food textures appropriate to the child's age [14]. Moreover, inadequate oral motor abilities cause reduced food intake, resulting in a significant proportion of malnourished children with neurodevelopmental disorders [15,16]. A child's feeding disorder also has implications on the child's family [3,12,17-19]. Parents of children with feeding problems report more stress with regard to social isolation and self-perception than parents of healthy children [20]. Meals and meal preparation take considerable time and result in less time for social activities or for the parent to do developmental activities with their child.

Several interdisciplinary interventions for children with feeding problems exist [4,21,22]. Although behavioral-based interventions have shown positive results in children with developmental disabilities,
they have not succeeded in improving oral motor skills in such a way that all food consistencies could be eaten [4,11,13,23]. Likewise, oral motor based programs do not address the behavioral aspect of the feeding disorder [24,25]. Therefore, it seems appropriate to combine the two approaches in a behavioral-based intervention with oral motor based elements. To do this, a systematic problem analysis should be the basis for designing a tailored intervention plan.

Such a systematic problem analysis should be based on both child specific problems as well as problems in the environmental conditions. The International Classification of Functioning, Disability and Health for Child and Youth (ICF-CY) of the World Health Organization [26] provides a framework to describe feeding difficulties along four dimensions: (1) Body Function/Structures [gastrointestinal conditions, respiratory status and/or neuromuscular conditions]; (2) Activity and Participation [eating, drinking, learning]; (3) Environmental Factors [parental reaction to the child's food refusal] and (4) Personal Factors [developmental issues, age]. This framework is helpful in both clinical practice and in research to analyze the complexity of feeding problems in children with feeding problems with various etiologies.

The purpose of this multiple case report is to describe the characteristics of children with feeding problems using the ICF framework and to gain insight into the influencing factors and the effectiveness of the interdisciplinary problem analysis and in-patient intervention to improve calorie intake and solid food consumption.

Methods

Participants

Children aged six months to six years were eligible for the intervention when (i) feeding difficulties had existed for a period of at least six months and (ii) feeding difficulties were related to physical etiology and/or were affecting the child's health status. Children with diagnosed psychiatric problems or severe developmental disabilities or children in palliative care were excluded from this study. We categorized the children into three groups depending on how the parents characterized the feeding problem. Of the 29 children, 41% were categorized as 'Tube feeding' (n = 12; 9 nasogastric tube and 3 gastrostomy tube), 21% were categorized as 'Selective food refusal by texture' (n = 6) and 38% were categorized as 'Unpredictable food refusal' (n=11). Characteristics of the participants are listed in Table 1.

<table>
<thead>
<tr>
<th>Total</th>
<th>'Tube feeding'</th>
<th>'Selective food refusal by texture'</th>
<th>Unpredictable food refusal</th>
<th>'Tube feeding'</th>
<th>'Selective food refusal by texture'</th>
<th>'Unpredictable food refusal'</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 (100%)</td>
<td>12 (41%)</td>
<td>6 (21%)</td>
<td>11 (38%)</td>
<td>29 (100%)</td>
<td>12 (41%)</td>
<td>6 (21%)</td>
<td>11 (38%)</td>
</tr>
<tr>
<td>Age in years Mean (SD)</td>
<td>2.3 (0.9)</td>
<td>3.5 (1.9)</td>
<td>2.5 (1.3)</td>
<td>2.5 (1.4)</td>
<td>2.3 (0.9)</td>
<td>3.5 (1.9)</td>
<td>2.5 (1.3)</td>
</tr>
<tr>
<td>Gender</td>
<td>Boys (n)</td>
<td>Girls (n)</td>
<td>Boys (n)</td>
<td>Girls (n)</td>
<td>Boys (n)</td>
<td>Girls (n)</td>
<td>Boys (n)</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>Range</td>
<td>Mean (SD)</td>
<td>Range</td>
<td>Mean (SD)</td>
<td>Range</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Weight (SD)</td>
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<td>-3.6 to 0.5</td>
<td>-0.4 (1.1)</td>
<td>-1.7 to 2.7</td>
<td>-1.3 (1.3)</td>
<td>-3.2 to 1.9</td>
<td>-2.4 to 2.6</td>
</tr>
<tr>
<td>Height (SD)</td>
<td>-1.2 (1.4)</td>
<td>-3.0 to 0.5</td>
<td>-1.0 (1.1)</td>
<td>-2.4 to 0.5</td>
<td>-0.3 (2.2)</td>
<td>-2.4 to 2.6</td>
<td>-0.9 (1.4)</td>
</tr>
<tr>
<td>Weight for Height (SD)</td>
<td>-1.9 (1.0)</td>
<td>-4.0 to -1.0</td>
<td>-1.1 (0.7)</td>
<td>-2.0 to -0.1</td>
<td>-0.9 (1.4)</td>
<td>-3.7 to 2.1</td>
<td>-0.9 (1.4)</td>
</tr>
<tr>
<td>Total</td>
<td>12 (41%)</td>
<td>6 (21%)</td>
<td>11 (38%)</td>
<td>29 (100%)</td>
<td>12 (41%)</td>
<td>6 (21%)</td>
<td>11 (38%)</td>
</tr>
</tbody>
</table>

Table 1: Characteristics of the participating children.

In each subsection of this article we present a representative case study per group.

'Tube feeding'

B. was a 1.6 years old girl with multiple respiratory problems, kidney dysfunction and delayed psychomotor development. At birth she presented with severe feeding problems and a nasogastric tube was used for feeding. Vomiting occurred at least twice a day. B. refused food by screaming and holding her breath. B.’s parents ceased feeding when B. started crying or vomiting. Because of the dependence of the tube feeding the parents were unable to enroll B. in a childcare facility and the mother had to resign from her job, which resulted in financial problems for the family.

Anthropometric data: SD of age-appropriate height was -2.9, SD of age-appropriate weight was -2.2 and SD weight for height was -0.3.

'Selective food refusal by texture'

J. was a 5.5 years old boy with unilateral cerebral palsy and mild developmental problems. He was referred for intervention to optimize his intake of solid and lumpy foods. He took medication for constipation. His parents reported long meal times, especially dinners, where J. was often angry and went into a rage. Parents reported that family meals were stressful for both them and their three children. J.’s parents also reported that they were inconsistent in their use of incentives to encourage J. to eat solid foods.
Setting and Materials

In this exploratory multiple case study data was obtained from 29 children participating in an in-patient feeding intervention at the rehabilitation centre of the Sint Maartenskliniek (Nijmegen, the Netherlands). Therapy sessions lasted 45-60 minutes (inclusive parental instructions) and were held three or four times a day based on the intervention of Clawson et al. [25]. The weekdays feeding intervention varied per child between four to six weeks depending on individual factors (e.g. intervention goal, child's physical condition, progression in oral intake and parent-child interaction and personal or environmental factors). The feeding sessions were held in a room by the psychological trainer or speech therapist. Between therapy sessions, the children played with peers.

Materials used in the feeding sessions were plastic children's tableware, regularly available foods and drinks for children, calorie supplements and interactive toys or internet applications with sound and moving elements.

Procedure

Clinical assessment

After enrolling in the center, parents were requested to keep a diary of their child's oral intake for seven days and to make a video recording of a representative mealtime with the family. At the assessment, a representative mealtime with the family. At the assessment, a representative mealtime with the family. The weekly feeding intervention varied per child between four to six weeks depending on individual factors (e.g. intervention goal, child's physical condition, progression in oral intake and parent-child interaction and personal or environmental factors). The feeding sessions were held in a room by the psychological trainer or speech therapist. Between therapy sessions, the children played with peers.

Materials used in the feeding sessions were plastic children's tableware, regularly available foods and drinks for children, calorie supplements and interactive toys or internet applications with sound and moving elements.

Parents were interviewed and asked about their thoughts and expectations about the intervention. The mealtime recording was analyzed by the psychologist in terms of the child's feeding-related behavior and family members' reactions to the child's behavior. Each child's assessment was distributed over a single day. After data analysis, the team met and used the ICF framework to determine the body functions, activities, environmental and personal factors. This information was used to formulate a hypothesis on the reasons for the feeding problem and the factors continuing the feeding problem. An overview of this analysis in terms of the ICF framework is illustrated in Table 2.

<table>
<thead>
<tr>
<th>ICF code</th>
<th>Description</th>
<th>'Tube feeding'</th>
<th>'Food refusal by texture'</th>
<th>'Unpredictable food refusal'</th>
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<td>Body function</td>
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<td>n=6</td>
<td>n=11</td>
<td>n=29</td>
<td></td>
</tr>
<tr>
<td>b 117/ b 147</td>
<td>Intellectual functions/ psychomotor function</td>
<td>4/12</td>
<td>2/6</td>
<td>1/11</td>
<td>7/29</td>
</tr>
<tr>
<td>b 122</td>
<td>Global psychosocial function</td>
<td>1/12</td>
<td>2/6</td>
<td>3/11</td>
<td>6/29</td>
</tr>
<tr>
<td>b 125</td>
<td>Dispositions and accommodation</td>
<td>4/12</td>
<td>1/6</td>
<td>9/11*</td>
<td>14/29</td>
</tr>
<tr>
<td>b 126</td>
<td>Temperament and personality functions</td>
<td>6/12</td>
<td>3/6</td>
<td>4/11</td>
<td>13/29</td>
</tr>
<tr>
<td>b 130</td>
<td>Energy and drives functions</td>
<td>6/12*</td>
<td>1/6</td>
<td>1/11</td>
<td>8/29</td>
</tr>
<tr>
<td>b 134</td>
<td>Sleep functions</td>
<td>1/12</td>
<td>6/11*</td>
<td>7/29</td>
<td></td>
</tr>
<tr>
<td>b 140</td>
<td>Attention functions</td>
<td>1/12</td>
<td>3/6*</td>
<td>2/11</td>
<td>6/29</td>
</tr>
<tr>
<td>b 152</td>
<td>Emotional functions</td>
<td>5/12</td>
<td>3/6</td>
<td>7/11</td>
<td>15/29</td>
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<tr>
<td>b 250/ b 270</td>
<td>Taste/Sensory function related to temperature and other stimuli</td>
<td>7/12</td>
<td>1/6</td>
<td>9/11</td>
<td>17/29</td>
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<tr>
<td>b 280</td>
<td>Pain</td>
<td>3/12*</td>
<td>1/11</td>
<td>4/29</td>
<td></td>
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<tr>
<td>b 435</td>
<td>Immunological system function</td>
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<td>4/11</td>
<td>9/29</td>
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<tr>
<td>b 510</td>
<td>Ingestion functions</td>
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<td>6/6*</td>
<td>7/11</td>
<td>19/29</td>
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<tr>
<td>b 515</td>
<td>Digestive functions</td>
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<td>3/6</td>
<td>7/29</td>
<td></td>
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<tr>
<td>b 525</td>
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<td>3/6</td>
<td>4/11</td>
<td>10/29</td>
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<td>b 735</td>
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<td>1/6</td>
<td>2/29</td>
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<td>b 760</td>
<td>Control of voluntary movement functions</td>
<td>2/12</td>
<td>3/6*</td>
<td>5/29</td>
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<tr>
<td>b 761</td>
<td>Spontaneous movement functions</td>
<td>1/12</td>
<td>2/6</td>
<td>1/11</td>
<td>4/29</td>
</tr>
</tbody>
</table>

Body structures
The intervention consisted of a behavioral program given by a psychologist, an oral motor program given by a speech therapist or a combination of both programs given by both the psychologist and the speech therapist. The behavioral program was based on various studies [13,15,24] and included positive reinforcement, tangible rewards (non-contingent access to preferred items), extinction of inappropriate behaviors and the use of shaping and fading techniques. During the behavioral therapy, the child sits on the therapist’s lap and is given a specific amount of food just under the child’s current acceptance level. When the child accepts this amount of food over three consecutive sessions, the amount is increased by 25 grams (if acceptance level was below 100 grams) or 50 grams (if acceptance level was above 100 grams). The child received a tangible reward (e.g. music toy) and/or verbal reward (‘well done’) after every bite in a standardized order.

The focus of the oral motor program was to practice the oral skills of managing different food consistencies. The child received standardized verbal instructions with visual and tactile support during the session. Regular contact was maintained between the psychologist, speech therapist and the dietician to ensure each child received optimal and adequate nutrition. Weekly meetings were held with the intervention team and the parents to discuss progress and child nutrition. Parents were taught feeding techniques and strategies on how to manage their child’s food refusal behavior.

Outcome Measures and Data Analysis

Outcome measures

Food intake was derived from the 7-day feeding diary. Average food intake was compared with the recommended amount of calories and fluid based on child gender, age, weight, height, activity level, disease factor and catch-up growth and was calculated by means of the Schofield formula [31]. Data on calorie intake (k.cal) was computed at three measurement moments: the week leading up to the assessment day (t1), the week prior to discharge (t2) and three months after discharge (t3). In addition to calorie intake we also collected group-specific data: for the ‘Tube feeding’ group we separated calorie consumption into the amount of solid, puree and liquid intake (k.cal).

Table 2: Overview of signs and symptoms classified in conformity with the International Classification of Functioning, Disability and Health (ICF) per feeding group.

| s 250 Structure of middle ear | 3/11* | 3/29 |
| s 330 Structure of pharynx | 1/12 | 2/6 | 4/11* | 7/29 |
| Activities/participation | Handling psychological demands | 2/12 | 1/6 | 7/11* | 10/29 |
| d 550 Eating | 7/12 | 4/6 | 7/11 | 18/29 |
| d 650 Drinking | 4/12 | 1/6 | 1/11 | 6/29 |
| d 710 Basic interpersonal interactions | 1/12 | 1/6 | 6/11* | 8/29 |
| d 815 Preschool education | 2/12* | 2/29 |
| Enviromental factors | 3/6 | 5/11 | 8/29 |
| e 110 Products or substances for personal consumption | 3/6 | 5/11 | 8/29 |
| e 310 Immediate family | 3/12 | 1/6 | 8/11* | 12/29 |
| e 410 Individual attitudes of immediate family members | 8/12 | 2/6 | 10/11* | 20/29 |
| e 580 Health services, systems and policies | 12/12* | 2/6 | 1/11 | 15/29 |

Table 2: Overview of signs and symptoms classified in conformity with the International Classification of Functioning, Disability and Health (ICF) per feeding group.
calorie intake per group into z-scores. All statistics were performed using SPSS (version 17.1).

Results

Treatment frequency and duration

The mean duration of the intervention was 4.3 weeks (60.7 therapy sessions). The 'Tube feeding' group received the most therapy sessions (mean 66.9) and the 'Selective food refusal by texture' group had the fewest number of sessions (mean 51.0). Frequency data for the 'Unpredictable food refusal' group are skewed as two children had an extended stay in the in-patient intervention due to family factors (inappropriate home environment and parental psychiatric problems). The parental coaching sessions are included in the count but sessions with the dietician are not included.

Tube feeding

Before the intervention, 12 children required tube feeding for 20 to 100% of their dietary needs. At discharge, two of these children were no longer receiving tube feeding and at follow-up another four children had ceased receiving tube feeding. The remaining five children (follow-up data of one child is missing) received (partial) tube feeding at follow-up (range = 30-90%). Two of them decreased tube feeding by 50 and 75% compared to pre-intervention data. Both these children had co-morbid medical problems (cardiac defect; multiple congenital malformations of the skeleton, muscles, heart and kidneys). The maximum duration of the feeding sessions was 30 minutes and these two children were often too fatigued to eat the necessary amount. The oral meals were completed with tube feeding to prevent stressful feeding sessions and malnutrition. Three children were not successful in decreasing the tube feeding, and had metabolic dysfunctions and also gastrointestinal problems with episodes of extreme vomiting. Figure 1 presents the evaluation of the oral feeding.

Figure 1: Food intake in percentage of the recommended amount of calories based on gender, age, weight for height, activity level, disease factor and catch-up growth of each child at t1 (n = 12), t2 (n = 12) and t3 (n = 11) for the 'Tube feeding' group.

Calorie intake

Figure 2 presents the information on calorie intake for children with unpredictable food refusal for the period from t1 to t3. In addition to an insufficient calorie intake, some children had a one-sided and incomplete menu at t1. Three months after discharge almost all children had a sufficient calorie intake. However, in 8 cases supplemental calories in powder form were added to food or drinks. The children with selective food refusal by texture generally had a sufficient calorie intake and they showed no significant change in calorie intake.

The 'Tube feeding' group had the largest improvement in calorie intake during the treatment (z-score Δ t1-t2 = 2.3; Δ t2-t3 = 1.1). The 'Unpredictable food refusal' group increased their calorie intake after the treatment more than during the treatment (z-score Δ t1-t2 = 0.7; Δ t2-t3 = 1.3). Results at follow-up suggest that parents of both groups were generally able to maintain and even increase the calorie intake at home.

Age appropriate oral intake

Children with selective food refusal by texture could be divided into those who did not accept solid food (n = 4) and those who ate solid and lumpy food but had poor chewing skills due to neurological problems (cerebral palsy, prematurity; n = 2). The therapy for all children in this group was focused on developing chewing technique rather than on increasing the amount of solid food consumed. As a result, the amount of solid food intake during treatment for this group decreased but increased after discharge. At follow-up the amount of solid food being eaten by the 6 children was more than double the pre-intervention amount (from 115 to 310 grams per day).

ICF framework

We shared the children into three groups based on their specific food intake. Using the ICF classification we noticed differences between the three groups and their environment. The children with tube feeding had physical problems and as a result of multiple medical treatments they were anxious about eating. Two of the children in this group were not able to enroll at childcare because of the tube feeding and/or vomiting.

The children with food refusal by texture showed more motor and attention problems and had difficulties with defecation, whereas children in the other groups had more vomiting.

The children with unpredictable food refusal had difficulties with psychosocial function, dispositions and accommodation and sleeping. Approximately 30% of these children had multiple ear inflammations, enlarged tonsils or food intolerance. Most parents of children in this group were unable to give clear structure and instructions or provide positive rewards for eating. This resulted in children not participating in family mealtimes and the child having his/her own ritual for eating. In three cases we were concerned about the child's social emotional development and we referred the child for further assessment.
Discussion and conclusion

In this study we described a 4-6 week in-patient multidisciplinary intervention including a behavioral program based on theories of operant conditioning combined with oral motor training, parental coaching and dietary support to provide treatment effective for children with feeding problems. For children with severe metabolic disorders the intervention had limited success in increasing oral food intake; however parents reported that their child vomited less and that the parents had more insight into their child's oral intake pattern.

The average length of the 4-6 week intervention in our study was shorter than in other studies; however, the number of therapy sessions required to reduce tube feeding is in line with these studies [12,22,24]. Parents were unanimously positive about the duration of the intervention, possibly because of the high frequency of intervention sessions. Studies report good results when parents are given a more prominent role in the intervention [25,32] and this fits with our findings. We did not systematically analyze the reduction of parental stress, but we hypothesize that providing parental training to transfer intervention elements to the home setting was a key factor for the success of our intervention. The in-patient setting enabled us to observe characteristics of both children and parents in addition to the feeding sessions. Parents were taught how to offer their child food, how to reward their child for food acceptance and how to ignore their child's refusal behavior. By changing the parent's perception and interpretation of their child's behavior, parents gained insight into their child's temperament and how to cope with the conflicts during feeding and during sleeping. Therefore, the primary goal for children with tube feeding was not eliminating the tube feeding as fast as possible, but rather focused on the capacity of parents to handle the refusal behavior of their child. Success was not limited to type or presence of chronic illness but also included the personal factors of the children, that is, the child's character and coping style as illustrated in the three cases.

Of the 29 children in the present study, 26 improved in their qualitative as well as in their quantitative food intake. The individual adapted menu with food supplements made by the dietician resulted in clear recommendations for parents and reduced worries about the food intake of their child. In our study, 67% of the children receiving tube feeding at admittance to the intervention had reduced the amount of tube feeding by the end of the intervention. Based on our findings, it seems that a total reduction of tube feeding in such a heterogeneous group is not to be expected, especially in cases with complicated medical issues such as in metabolic illness.

Although we did not quantify the degree of improvement in oral motor skills in children with 'selective food refusal by texture', we found that the average amount of solid food consumed almost trebled for the group at follow-up. The subgroup of children with neurological impairments was able to improve chewing technique, which led to a safer handling of solid and lumpy foods. This is in line with the results published by Clawson et al. [25]. Parents learned to stimulate good chewing and to adapt the meals to the oral motor abilities of their child.

Definite conclusions on the success of the intervention need to be postponed. We tried to handle the heterogeneity of the group in this study by defining subgroups based on the feeding problem instead of based on the diagnosis, which seemed appropriate as the ratio of behavioral and oral-motor program components was linked to the goal of the intervention. This, however, was not independent of the subgroup profile. This study offers insight into the barriers and strengths of the designed intervention and provides a solid basis of information for a future study with a larger cohort.

Acknowledgement

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References