

# Identification and analysis of the responsible causes for reoperations of strabismus

## *Identificação e análise das causas responsáveis por reoperações de estrabismo*

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### ABSTRACT

**Introduction:** The difficulty in obtaining predictable results is a great challenge on the strabismus surgery field. Procedures can lead to an undesirable development in about 51% of patients, and this difficulty may be due to surgery being performed on soft periocular tissues in which anatomical structure can be tricky to locate. **Objective:** Identify and analyse the main causes of reoperation on strabismus surgery patients treated at Centro Oftalmológico do HUUFMA, in São Luís-MA. **Methods:** A retrospective documental research based on institutional registries, through data collection from physical and electronic patient records of HUUFMA's ambulatorial internal system. **Results:** The analysed reoperation rates were in about 7,31%. 89 patients under 15-year-old (72,35%), 23 patients aged between 15 to 30 (18,69%), and 11 patients over the age of 30 (8,94%) were submitted to surgery, with total number of 123 patients and mean age of 10,32 years. Female patients have prevailed in the population (58,53%). **Conclusion:** Esotropic deviation was the most common deviation in the reoperated group. The unexpected results and greatest deviations occurred on patients with reported comorbidities and/or syndromes associated with strabismus, such as dissociated horizontal deviation (DHD), which was prevalent among the presented complaints. General anesthesia was most reported in lower age patients. The average time elapsed between the first and the second procedure was 10,54 months, and a relative prevalence of the undercorrections occurred on reoperations procedures.

**Keywords:** Reoperations; Strabismus; Child

### RESUMO

**Introdução:** A dificuldade na obtenção de resultados previsíveis é um grande desafio atual da cirurgia corretiva de estrabismo. Os resultados não desejados podem ocorrer em cerca de 51% dos procedimentos e a dificuldade pode ser devida ao fato da cirurgia ser realizada sobre tecidos perioculares bastante moles e com difícil referência para a localização anatômicas das estruturas. **Objetivo:** Identificar e analisar as principais causas responsáveis por reoperações nos usuários submetidos à cirurgia corretiva de estrabismo, atendidos no Centro de Oftalmológico do HUUFMA, em São Luís-MA. **Métodos:** Estudo do tipo pesquisa documental retrospectiva dos registros institucionais, por meio da coleta de dados dos prontuários físicos e eletrônicos no sistema ambulatorial interno do HUUFMA. **Resultados:** A taxa de reoperação analisada foi de 7,31%. Foram operados 89 pacientes menores de 15 anos (72,35%), 23 na faixa de 15 a 30 anos (18,69%) e 11 pacientes maiores de 30 anos (8,94%). A média da idade dos 123 operados foi de 10,32 anos. O sexo feminino foi prevalente na população (58,53%). **Conclusão:** O desvio Esotrópico (ET) foi o tipo de desvio mais comum no grupo de reoperados. Os resultados inesperados e os maiores desvios foram nos pacientes com relatos de comorbidades e/ou síndromes associadas ao estrabismo, assim como o desvio horizontal congênito (Dhc) foi prevalente entre as queixas apresentadas. A anestesia geral foi mais relatada em pacientes de menor faixa etária. O tempo médio decorrido entre a primeira e a segunda cirurgia foi de 10,54 meses e houve relativa prevalência das subcorreções nas reoperações.

**Descritores:** Reoperações; Estrabismo; Criança

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## INTRODUCTION

The difficulty in obtaining predictable results is a major challenge in strabismus corrective surgery.<sup>(1)</sup> Even with the prevention adopted in the surgical plan, many unexpected results justify the need for other approaches.<sup>(2)</sup>

At the same time, it should be noted that: secondary operations are common and the factors to justify them are controversial,<sup>(3)</sup> and there are few scientific reports specifically addressing the reasons for reinterventions

## METHODS

The present research was developed at the Ophthalmological Center of Hospital Universitário da Universidade Federal do Maranhão (HUUFMA) in São Luís -MA, with the collection of data from physical and electronic medical records in the internal ambulatory system of the department, through information filed between the August 2012 to July 2016. A retrospective documentary research study of the institutional records was developed.

The initial data collection was performed by checking the general map of surgical procedures, the amount of all patients who underwent strabismus surgery during the aforementioned period. Then, the repeated records were categorized, and the cases of suspended or canceled surgeries were excluded. During follow-up, the medical records were divided into two groups based on the following criteria:

Group 1: those who did not need reoperation in the period studied;

Group 2: those who needed reoperation in the period studied.

The research population include all the users of the service who were registered on the surgery map of the department during the aforementioned period, and the sample was extracted from the medical records reporting cases of reoperation and/or requiring recorection after the first procedure, no matter the extra number of surgeries performed. We excluded from the collection the cases in which some intervention did not occur at the study site, or those in which the medical records were not found.

The collection instrument was a spreadsheet in the program Microsoft Office Excel, with the collection and ordering of relevant hypotheses, such as: identification, pre-surgical data, clinical findings, surgical planning, main justifications, and post-surgical data. After organizing and plotting the data based on the research objective, the various elements that could justify reoperations were compared, extracted, deduced and analyzed. It was a quantitative-qualitative descriptive statistical analysis.

First, the results were interpreted with calculations of averages, frequencies and variants, and then demonstrated in figures and tables. Then, the set of information was deeply analyzed, discussed and compared to the hypotheses and premises of other important studies in the area.

### Ethics

The present research consisted of the due legal process, as it was submitted and approved by the Research Ethics Committee – CEP-HUUFMA, in accordance with the duties defined in Resolution CNS No. 466/2012 and Operational Rule No. 001 of 2013 of CNS on research involving human beings, with the following number of opinion: 1,960,618, as of March 12, 2017.

## RESULTS

A total of 123 medical records were identified. Of this amount, 9 (7.31%) described the need for reoperations, and 114 (92.68%) did not report corrective surgeries.

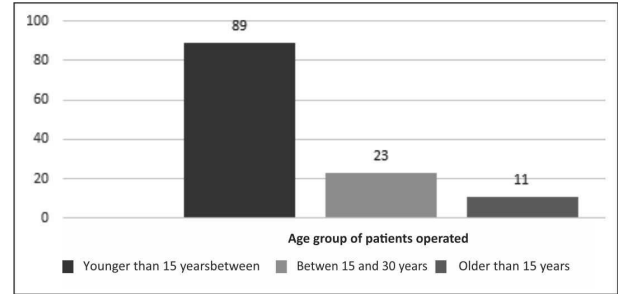


Figure 1: Total quantitative ratio of surgeries by age group

According to figure 1, 89 patients under the age of 15 (72.35%), 23 in the range of 15 to 30 years (18.69%), and 11 patients over 30 years (8.94%) were operated. The average age of the 123 patients operated was 10.32 years. In addition, 51 (41.46%) patients who underwent strabismus surgery were male, and 72 (58.53%) were female.

Of all medical records identified, 67 (54.47%) indicated unilateral surgeries, sometimes only in the right eye, other times only in the left eye, and 56 (45.52%) described bilateral surgical procedures. In Group 2 (patients requiring reoperation in the period under study), two had the first surgery unilaterally, and seven had it in both eyes, as showed in figure 2.

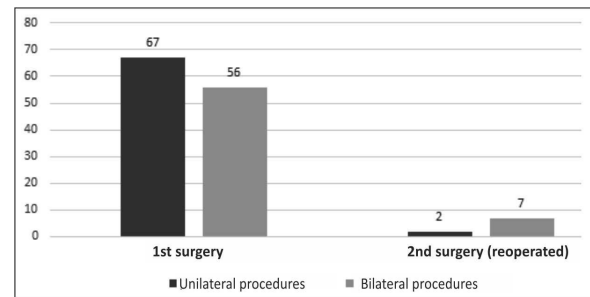


Figure 2: Comparative profile between the quantitative and the laterality of the surgical procedures

Table 1 shows that in the group of patients reoperated 55.55% of patients are male, the average age is 11.04 years, ranging from 1 to 40 years. When selecting the percentages of children under the age of 15 and of those over the age of 30, we obtain 77.77% and 11.11%, respectively. In addition, six patients identified as 1, 2, 3, 5, 8 and 9 report the presence of signs and symptoms of comorbidities and/or diagnosis of syndromes, and three (4, 6 and 7) did not report these conditions.

Regarding the type of deviation studied in the preoperative period of the first operation, six (66.66%) presented esotropia (ET) and three (33.33%) exotropia (XT), with average deviation of ET = 50.63di and XT = 79.92di, ranging from 40 to 65di and from 60 to 90di, respectively. The average age of each group of patients by deviation before the first surgery was 5.31 years for those with ET, and 22.66 years for the XT group.

When analyzing table 1, Krimsky data in the primary position of the gaze (PPG) of the 3 medical records not describing the presence of comorbidities or syndromes in the preoperative period of the first intervention (4, 6 and 7) have average deviation of 43.30di, with ET50, ET40 and ET40di,

respectively. The results of Krimsky in PPE presented among the 6 medical records referring to the presence of comorbidities and/or syndromes (1, 2, 3, 5, 8 and 9) have average deviation of 68.89di, with XT90, XT60, ET65, ET50, XT90 and ET60di, respectively.

**Table 1**  
Main preoperative aspects of the first intervention in patients who underwent reoperation of strabismus

ID	1	2	3	4	5	6	7	8	9
Gender	M	F	F	F	F	M	M	M	M
Age (years)	40	26	1	3	8	7	9	2	4
Comorbidities and/or Syndromes	Y	Y	Y	N	Y	N	N	Y	Y
Associated complaints	HtD HotD	Seizure and sensory deficit	Dhc	Dhc	Chronic headache	Dhc	Dhc	Dhc	Dhc
Krimsky in PPE (Diopters)	XT90	XT60	ET65	ET50	ET50	ET40	ET40	XT90	ET60

ID = identification; M = male; F = female; Y = yes; N = no; XT = exotropia; ET = esotropia; HtD = hypertropia; HoD = hypotropia; PPG = primary position of the gaze; Dhc = congenital horizontal deviation.

**Table 2**  
Main postoperative aspects of the first intervention in patients who underwent reoperation of strabismus

ID	1	2	3	4	5	6	7	8	9
Type of anesthesia	Peribulbar	Peribulbar	General	General	General	General	General	General	General
Surgical risk (ASA)	1	1	1	1	1	1	1	1	1
Side operated	U	U	B	B	B	B	B	B	B
Surgical plan performed	RsRLR 7,0mm + auto-Tx RLR +Tenectomy URO 8,0mm	RcRLR 6,0mm	RcLMR 6,0mm +RsLLR 6,0mm + RcRMR 5,0mm	5U Btx MR BE	RcRMR 6,5mm +RcLMR 6,0mm	Double RcME 6,0mm	Double RcME 6,0mm+ RsRLR 6,0mm + RsLLR 5,0mm	TxRLR para RMR	Double RcMR 6,0mm + pleating RLR 5,0mm
Krimsky in PPG (Diopters)	XT90	XT60	ET65	ET50	ET50	ET40	ET40	XT90	ET60

ID = identification; ASA = American Society of Anesthesiologists; BO = both eyes; U = unilateral; B = bilateral; PPG = primary position of the gaze; XT = exotropia; ET = esotropia; RsRMR = resection of the right medial rectus; URO = upper right oblique; RcRLR = recess of the right lateral rectus; RcLMR = recess of the left medial rectus; RsLLR = resection of the left lateral rectus; RcRMR = recession of the right medial rectus; MR = medial rectus; RcMR = recess of the medial rectus; RsRLR = resection of the right lateral rectus; TxRLR = transposition of right lateral rectus; RMR = right medial rectus; Btx = botox; U = units; Tx = transplantation.

When evaluating the post-surgical aspects of the first intervention present in table 2, the group of medical records identified by 1 and 2 and the group of medical records 3, 4, 5, 6, 7, 8 and 9 describe that the anesthesia used in the procedure was peribulbar block and general anesthesia, in that order. In other words, in patients who were reoperated the peribulbar block was predominant in the group of users with the highest average age (1 and 2), and in parallel general anesthesia was the most used one in the group of lower age (3, 4, 5, 6, 7, 8 and 9), according to the analysis of tables 1 and 2.

All medical records of Group 2 mention low surgical risk, with ASA 1 (American Society of Anesthesiologists) for the

surgical procedures in the first intervention, according to table 2.

Regarding the type of deviation studied in the postoperative period of the first operation, 4 out of the 9 reoperated presented esotropia (ET) and five exotropia (XT), with average residual deviation of ET = 27.5di and XT = 28di, ranging from 15 to 35di and from 10 to 40di, respectively. In Group 2, in each surgical period, the ratio of total ET and XT (ET/XT) patients was 6:3, 4:5, and 1:8 in this sequence, as interpreted in tables 1, 2 and 3.

Com relação ao lado operado, a interpretação da tabela 3 infoRegarding the side operated, the interpretation of table 3 shows that in the first surgery of Group 2 the patients with the highest average age (1 and 2) underwent the intervention unilaterally,

**Table 3**  
**Main postoperative aspects of the second intervention in patients who underwent reoperation of strabismus**

ID	1	2	3	4	5	6	7	8	9
Side operated	U	B	U	B	U	B	U	U	B
Time between 1st and 2nd surgery (months)	2	3	11	11	16	3	34	8	7
Surgical plan performed	Explored RLR + RsRMR 5,0mm + PPT BE	RsRMR 5,0mm + RcRLR 5,0mm	RcRMR 6,0mm	Double RcMR 5,0mm	Explored LMR	5U Btx MR BE	RcLMR 5,0mm+ RsLLR 5,0mm	5U Btx RLR	Explorado MR BE
Number of reoperations	2	1	1	1	1	1	1	1	1
Krimsky in PPG (diopters)	XT20	XT10	XT15	ORTO	ET8	ORTO	ORTO	XT10	XT15

ID = identification; U = unilateral; B = bilateral; BE = both eyes; PPG = primary position of the gaze; XT = exotropia; ET = esotropia; RsRMR = resection of the right medial rectus; RcLMR = recess of the left medial rectus; RLR = right lateral rectus; RsLLR = resection of the left lateral rectus; RcRMD = recession of the right medial rectus; RcRLE = left lateral rectus recess; MR = medial rectus; RcMR = recess of the medial rectus; RsRLR = resection of the right lateral rectus; TxRLR = transposition of right lateral rectus; RMR = right medial rectus; PPT = posterior partial tenectomy; Btx = botox; U = units; ORTHO = orthotropy; mm = millimeters

whereas patients with the lower average age (3, 4, 5, 6, 7, 8 and 9) underwent surgery bilaterally. The average time elapsed between the first and second

The justifications found for the new surgical intervention were undercorrection and dissociated vertical deviation (DVD) in medical records 1, undercorrections in medical records 2, 3, 4, 5, 6 and 8, and overcorrection in medical records 7 and 9.

All reoperations presented horizontal deviations greater than 40di and average deviation of 60.49di in the first surgery. In the second intervention, the average deviation was 23.85di, and the greatest deviation recorded was 40di.

In the technical description of the muscles manipulated and approached in the surgical plan of the first intervention in the group of reoperated there are descriptions of the recesses of the medial rectus in five medical records (3, 5, 6, 7 and 9); resections of the lateral rectus in 2 medical records (3 and 7); transplants of lateral rectus in two (1 and 8); resection of the medial rectus in 1; recess of lateral rectus in 2; and tenectomy, application of botox and pleating in the records identified by 1, 4 and 9, respectively. In the same technical description, the average of the recesses in the medial and lateral rectus was 5.89 and 6.00 mm in that order, and the average of resections in the medial and lateral rectus was 7 and 5.66 mm, in due sequence.

## DISCUSSION

A taxa de reoperação encontrada foi de 7,31% e a média da idade da população operada (Grupo 1 e 2 juntos) foi de 10,32 anos, enquanto que a da amostra reoperada (Grupo 2) foi de 11,04 anos. A população feminina foi prevalente na amostra estudada (58,53%).

Even considering the rate of reoperation of the present study underestimated compared to other studies,<sup>(4,5)</sup> it is equivalent to several results, among them a study from São Paulo<sup>(6)</sup> evaluating reoperations in congenital and essential non-acquired esotropia,

as well as another survey performed at Hospital de Base do Distrito Federal,<sup>(7)</sup> which obtained variations in the reoperation rates from 9.9% to 10.2% and 10.7%, respectively. On the other hand, there are references emphasizing much larger variations, such as the international study cross-linking data from corrections made by adjustable and non-adjustable sutures,<sup>(3)</sup> which mentions variations in rates from 9.7% to 20%, that is, overlapping the reoperation rate found.

In the recent survey of Hospital de Base do Distrito Federal,<sup>(8)</sup> the average age of operated patients was 12.7 years, with a prevalence of 54.4% of females, and 49% of total esotropia operated were in children, with 16% of them younger than 2 years. Said findings relate to a study in Natal.<sup>(9)</sup> That is, there is similarity in the predominance of female children in surgeries for correction of strabismus, according to our results.

When analyzing figure 2, the quantitative of unilateral procedures was greater in the first surgery, whereas in the reoperations more bilateral procedures were performed. We have not found many works in the literature justifying this fact. However, there is a study about the results of the Carlson-Jampolsky technique<sup>(10)</sup> showing similar success rate between bilateral and unilateral procedures.

When evaluating the presence of comorbidities/syndromes in table 1, it is pointed out that even if the sample was relatively small when compared to international studies, the unexpected results and the greatest deviations in PPG were in patients with comorbidities and/or syndromes associated with strabismus. There are reports of associated complaints in the following proportion: six of congenital horizontal deviation (Dhc), one of hypertropia/hypotropia (HtD/HotD), one of chronic headache, and one of seizure with associated neurological and sensory deficit.

This association is relatively described in a publication in Iran<sup>(4)</sup> which studied risk factors related to reoperations and found strabismus to be associated with rare complex syndromes. Nevertheless, it points out that the majority of cases recorded in the world are not of syndromic strabismus. That same Iranian study concluded that deviations above 30 di and the action of the

lateral rectus muscle were risk factors for reoperation, and they may determine reapproaches.

Another publication in Turkey<sup>(3)</sup> listed and evaluated with a retrospective 2-year study the epidemiological factors and preoperative clinical features that affected the surgical success rate in strabismus, and concluded that only the preoperative fixation preference without amblyopia and initial average deviation were risk factors for failure of reoperations.

Thus, the predominance of 6 of the 9 patients reoperated with comorbidities/syndromes, according to Table 1, is associated with large deviations, since the 6 patients with this condition have average deviations of 68.89di compared to 43.3di of the medical records that do not refer to this pre-surgical condition, that is, the greatest average deviations were in comorbidities/syndromes patients. It is also inferred that the etiology of the great deviation may indirectly be related to the greater involvement of structures<sup>(1)</sup> acquired in comorbidities and/or syndromes.

Compared to the total population of operated patients, there is a simple inversion of the gender pattern, with a slight predominance of men (55.55%) in the 2nd intervention. A study carried out in São Paulo<sup>(11)</sup> shows gender similarities in a large sample subgroup of patients submitted to strabismus surgery. There was no change in the reoperated age group of the present study, i.e., most reapproaches (Group 2) remained in children, similarly to the total operated population (Group 1 and Group 2).

When comparing the most prevalent types of deviations in the study, we found that XT had a greater average in the angle of deviation (79.92 di), as well as the higher average age (22.66 years). It was also observed that, according to Tables 2 and 3, the same prognostic pattern is repeated, and in patients with minor deviations the orthostatic position was obtained at the end, whereas in the group with the greatest deviation minimum residual deviations are still mentioned.

In addition, according to national publications,<sup>(8, 12)</sup> similarities were observed in the relation between ET/XT and the age group, which tended to decrease with increasing age of the sample groups. Thus, ET is the most prevalent deviation in childhood, and XT prevails in the highest average age group. On the other hand, the number of residual ET deviations was also reduced in comparison with the increase in residual XT deviations, chronologically following the interventions.

The peribulbar block was more described in patients of older age groups, whereas general anesthesia was in children. It is inferred that even with the peribulbar block being scientifically described as safe in the trans and postoperative periods,<sup>(13)</sup> it is infeasible in children and young adults because it requires great patient cooperation.<sup>(14)</sup> Thus, the predominance of general anesthesia in the reoperated sample is justified.

The average time elapsed between the first and second surgeries in the group of reoperated patients was 10.54 months. There was little comparative reference of this characteristic, since most of the studies cross the time elapsed from the first surgery with pre-established segments and characteristics, such as the Iranian work<sup>(5)</sup> that mentions exclusively children with residual esotropia above of 15 di, with indication of reoperation 3 months after the first surgery. On the other hand, a Cuban publication<sup>(15)</sup> shows the risk of correcting esotropia in children younger than 12 months old.

There was a relative prevalence of undercorrections in reoperations, a similar fact in national and international literature.<sup>(6, 16)</sup> Thus, all nine patients reoperated have great deviation, as demonstrated in a similar study.<sup>(6)</sup> Of these, three

describe orthotropia in the postoperative period, and the remainder report minimal residual deviations ranging from 8 to 20 PD (Prismatic Diopter). When considering orthotropy, eso or exodeviation of up to 10 PD in the postoperative period as surgical success,<sup>(17)</sup> we emphasize the effectiveness of six reinterventions in this study.

At the same time, the three remaining reoperated patients who are not part of the surgical success<sup>(17)</sup> showed significant improvement in the great initial deviation, which suggests the benefit of reintervention, as seen in the Brazilian publication demonstrating that strabismus interferes with the patient's quality of life.<sup>(18)</sup>

It is also inferred, according to the literature, that the difficult predictability of strabismus corrections is motivated by several intrinsic factors of unique tissue characteristics<sup>(1)</sup>, as shown in a study using 10 monkeys of different species submitted to experiments with magnetic resonance imaging of the nerves and structures of extraocular muscles.<sup>(19)</sup>

In our study, no institutional reports were found about the presence or absence of amblyopia in the nine patients reoperated, nor about the types of suture threads involved.

## CONCLUSION

Therefore, the reoperation rate was below the main Brazilian references. Most surgeries were performed in children, in whom general anesthesia was the most used one. All reoperations aimed at correcting large deviations angles, and obtained significant improvement of the initial deviations. XT was predominant, with a higher average age and angle of deviation, in contrast with ET, which presented a lower angle and patients of younger age group. In addition, all of the reoperated patients who reported syndromes and/or comorbidities had the greatest initial deviations, and the three patients who did not report of syndrome and/or comorbidity had the best PPG at the end of the interventions. It should be noted that in all reoperations the initial deviation was high, and the subcorrections were more incidental.

Throughout the research, there were variations in the techniques of approach, different standardizations that may have underestimated the delimitation of the sample studied. However, the identification and analysis of the main factors responsible for reoperations at Centro Oftalmológico do HUUFMA allowed us to know the main clinical characteristics of the deviations, the corrections and ocular reoperations of the patients of a great reference center in strabismus in Maranhão.

Among the main impacts of the present study is the short and medium term expected to develop protocols and techniques already existing in the strabismus services of HUUFMA, as well as to contribute in the long term to increase the predictability of this approach, thereby reducing the number of extra surgeries, expenses, future complications, and also to improve the logistics of reference systems for the early detection of the main factors responsible for reoperations of strabismus in Brazil.

### **Contributors**

- Jorge Antônio Meireles Teixeira: Creation, project execution, guidance, supervision, essay writing, critical review, and approval of the final version to be published.

- José Rodolfo Teixeira da Cunha: Creation, project execution, essay writing, data interpretation, critical review, and approval of the final version to be published.

- Lailson Oliveira de Castro: Data analysis and interpretation, essay writing, and approval of the final version to be published.

- Lyra Priscila Torres Almeida: Data analysis and interpretation, essay writing, translation, and approval of the final version to be published.

- Thallisso Martins da Silva Rodrigues: Data analysis and interpretation, essay writing, and approval of the final version to be published.

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