

IATROGENIC RETRACTION OF THE QUADRICEPS#

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Abstract

Quadriceps retraction after intramuscular injections requires a great attention, considering the fact that it causes a serious disability. The condition appears in children born prematurely or underweight that was hospitalized for a long time during the neo- natal period and in the first years of life. The knee's stiffness represents a surgical illness, but the general practioner (GP) has the duty to prevent it. The GP should be aware of the risk the intra-muscular injections have in new-born and disabled children (1,8,9). If, still, the disease has been identified and clinical signs are present, the pediatricians and family physicians have the duty to guide the earlier treatment of these children in a department of pediatric surgery and orthopedics.

Also, after being discharged from surgical departments, family physicians and pediatricians must pursue their rehabilitation for a long time because the post-operative evolution can be difficult, walking again can cause many problems, complications can occur, and relapses.

It is very important to be familiar with this disease in pediatric practice. The topic is of out most interest for the pharmaceutical industry because it brings forward the issue of creating new drugs to be administered by routes other than intramuscular one, but with the same efficiency and tolerance.

Key words: quadriceps retraction, intramuscular injection, neonates, extraperiosteal desinsertion of the thigh muscle.

Introduction

The contraction of the quadriceps in childhood may be congenital or secondary to a different variety of reasons. This study discusses the femoral quadriceps muscle sclerosis, induced by injection in the thigh muscle and sclerosis resulting in a progressive painless limitation of knee flexion(2,10,11). All children had suffered from serious illnesses since the first weeks of life for which they had received intramuscular thigh injections. A thigh dimple was noticed in all patients (Lloyd Roberts and Thomas 1964).

The mechanism by which these injection induced contractures develop is speculative. In the case of infants and babies the muscle mass is small and, for most of those babies included in the study who were born prematurely, the muscle mass must have been even smaller. Due to the volume of injected drugs, the compression of muscules and capillaries can result in significant muscle ischemia.(Gray 1967).The experimental trauma of a single intramuscular injection seems to cause disruption of muscle fibers with

local necrosis and subsequent muscle fibrosis (Engel 1967); local drug toxicity may, also, play an important part(Chiu et al1974). It is interesting to point out that the damage to the muscle after injection is different from the damage caused by vascular injury. Unlike the ellipsoidal forearm heart attack, described by Seddon (1972), where Volkman's contracture is immediately obvious, after the injection therapy there is a considerable delay before contractures develop in the thigh. In our study, the age at admission varied from1 year to15 years.

Williams (1968) has suggested that injection induced contractures may be related to unequal growth of muscle and bone. At first the healthy distal muscle fibers can compensate for the bone growth and ,as a result, there is no visible effect on the knee for several years after the injection treatment.

Subsequently, it reaches a point where the healthy muscle can no longer lengthen in proportion to the bone growth and contracture becomes apparent.

The differentiated growth between bone and muscle cannot be the only one responsible for any worsening of the patient's condition.

If contractures of this type are left untreated, secondary changes may occur in soft tissues, cartilage and bone of the neighboring joint. (Bose and Chong, 1976).

Some authors have observed that good results are achieved through the surgery of reinsertion of thigh muscle for mobilization the knee.

In conclusion, we believe that the most appropriate surgical treatment for children with contractions of the quadriceps caused by infection is reinsertion of the thigh for knee mobilization. The surgery eliminates the complication of a persistent extension lag (3,12). Postoperative mobilization can be quicker and the scar produces a more acceptable cosmetic result. A satisfactory range of flexion has been achieved in all our patients.

Aim of the paper. Material. Methods

This paper is based on the casuistic of the Clinic of Orthopedics' and Pediatric Surgery in Bucharest and Galati, over a period of twenty years, between1989-2009.

A retrospective and statistical study was conducted based on:

- The observation sheets of 200 children operated for iatrogenic quadriceps retraction;
- Postoperative protocols;
- Histopathological examinations.

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Between 2004 -2009 active calls were made for medical check-outs in the same centres where the postoperative results were analysed:

- After the knee flexion obtained postoperatively;
- After patellar position;
- After the age at surgery;
- After the postoperative scar;
- After walking, running, climbing and gender distribution, environment origin and location of the disease;

These classifications have been made for the clinic of Pediatric and Orthopedic Surgery in Bucharest and Galati, to be used as a comparative test. The study takes into account the following aspects:

- Frequency of the disease in years (table 1)
- Frequency index (table 2)
- Prevalence of the disease for each sex (table 3)
- Environment of origin (table 4)

- Location of the disease(table 5)
- age (table 6)

The social aspect is also of outmost importance, considering the fact that a great number of patients come from institutionalised centres.

One more reason for this paper is the observation that due to the increased popularization of this condition, the number of cases dropped for a certain period of time.

In order to be better understood and for achieving its goal, this paper was structured into a theoretical presentation of the disease and a detailed presentation of cases.

Catamnestic study

Frequency of the disease

Table 1, fig. 1 shows that frequency of cases has decreased progressively and the explanation would be both an absolute decrease in the number of cases but also a greater involvement of the competent services, which was the result of a better knowledge of the disease in the field.

Table 1: Frequency in years.

YEAR	NUMBER of CASES
1989	25
1990	20
1991	15
1992	20
1993	18
1994	19
1995	17
1996	10
1997	8
1998	6
1999	5
2000	5
2001	4
2002	4
2003	3
2004	4
2005	4
2006	4
2007	4
2008	3
2009	2
TOTAL	200

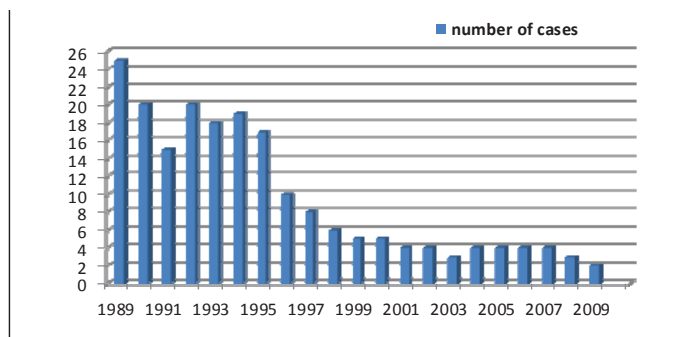


Fig. 1. Number of cases.

Frequency index (Table 2, Fig. 2), representing the number of reported cases of RIC from the total number of hospitalized children in the clinic, was 0, 31% in 1989, 0,

19% in 1993, 0, 09% in 2009. These figures reflect the incidence of the disease and are, also, a warning to pediatricians, imposing measures of prevention.

Table 2: Frequency index.

YEAR	NUMBER OF ADMISSIONS	NUMBER OF CASES	%
1989	10245	25	0, 31
1993	10773	18	0, 19
2009	11440	1	0, 09

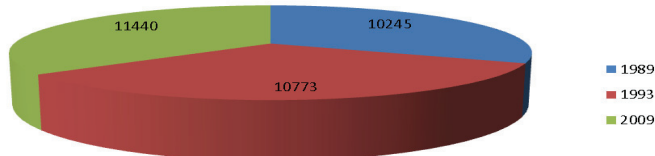


Fig. 2. Number of admissions / year.

Sex

One can note the prevalence of disease in females (Table 3, Fig. 3). Thus, from 200 cases of RIC, 165 were girls (62%) and 35 boys (38%). These data were found in

the specialized literature, where the same ratio of 2 / 3 girls and 1 / 3 boys is mentioned. We do not have a scientific explanation of this scale, though some have blamed an unknown, constitutional factor, predominant in girls.

Table 3: Sex ratio.

BOYS	35	38%
GIRLS	165	62%

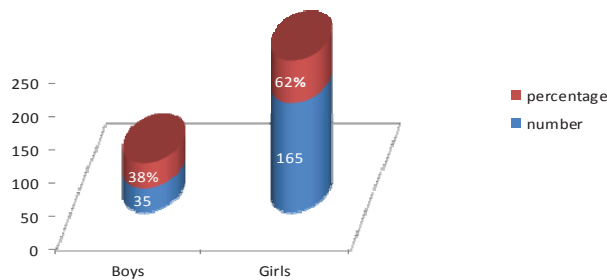


Fig. 3. Sex ratio.

Environment of origin (table 4,fig.4)

Statistics show an almost equal incidence, however, insignificant in relation to the social environment: 106 cases (53%) in urban and 94 cases (47%) in rural areas, indicating

similarity of curative care. Important to mention, is that the disease occurs frequently in children from institutionalized centers (145 cases), aspect which requires informing the responsible factors in these institutions.

Table 4: Environment

URBAN	106	53%
RURAL	94	47%

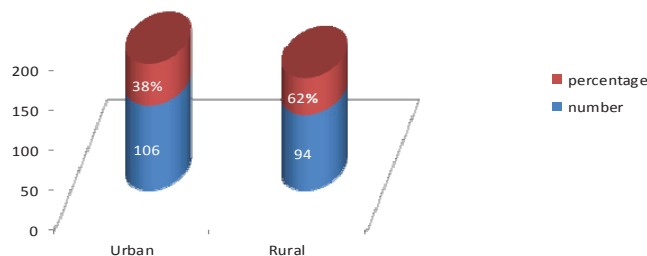


Fig. 4. Environment.

Location of disease (Table 5, Fig. 5) was as follows: 45 cases unilateral right, unilateral left 63cases, bilateral 71.

Taking into account the bilateral cases, our cases make up a total of 249 operated hips.

Table 5: Location of disease.

BILATERAL	71	41%
RIGHT	45	26%
LEFT	63	33%
TOTAL	249	

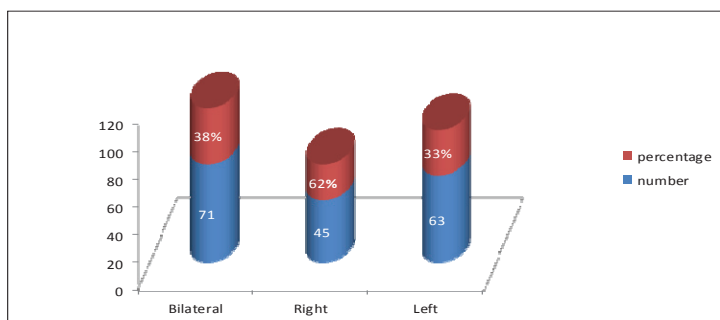


Fig. 5. Location of disease.

Age (table 6, fig. 6) has been the most difficult to establish because it relies only on their parents' assessment, subject to error, the onset of disease is often confused with a delay in walking due to other causes. We managed to get a

statistics on age groups, both based on the history of the case report forms and on the history taken from parents in the checking.

Table 6. Age groups.

AGE	NO. OF CASES
0-1 years	24
1-2 years	77
2-3 years	44
3-4 years	36
4-5 years	8
5-8 years	6
Over 8 years	5

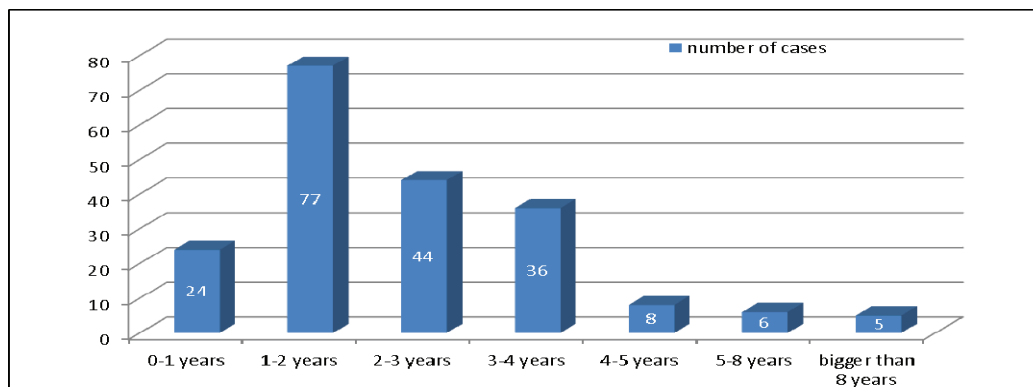


Fig. 6. Age groups.

We see from this table the frequency of the disease onset between 1-4 years (181 cases) as evidence of the consequences of the treatment carried out during the

neonatal period and in the first years of life, therefore the importance that should be given to injection treatment in the thigh.

Surgical treatment

The technique (fig. 7) was inspired by Judet's method, but adapted to the knee's stiffness by iatrogenic quadriceps retraction, aiming to obtain better functional results and avoid as far as possible, the disadvantages of other techniques. The current technique is an extraperiosteal reinsertion of the quadriceps and lowering associated with external patellar fin-clipping, in order to widen the strap that secures the patella and allows its lowering in a normal position through a single incision made in the postero-external side of the thigh; groin incision iliac crest begins at 2 cm behind the anterior-superior spina, going down and backward to circle the great trochanter and then follows the septum between the anterior and posterior muscles up to one third of the lower thigh, where it curves backwards and ends just at the edge of the patella, 1cm from its external edge(4).

The incision involves the skin, subcutaneous tissue and fascia lata, which continues within the intermuscular septum. Vastus lateralis is detached from the intermuscular septum up to the rough line where it is detached from the femur. The reinserted fibres are cut with the scissors in order not to damage the periosteum.

The reinsertion is made on the whole surface of the vastus lateralis from the great trochanter up to the femoral condyle. Along with the vastus lateralis is also reinserted vastus intermedius. In the upper side of the incision we enter

in the space between tensor fascia lata and buttocks, which is reinserted from the crest and anterior-superior iliac spine. The reinsertion of the tendon relaxes aponeurosis and enables exploring the direct and reflected tendons of the right femur. The direct and reflected tendon are sectioned from the anterior-inferior iliac spine which enables flexion of the knee(5,6).

This should be gently flexed and if it fails, the areas under tension should be examined and must be thoroughly and carefully identified and sectioned. Sometimes the reinsertion of the tailor muscle is very necessary and compulsory. We also don't want to damage the vascular – nerve bundles of the thigh and, especially, of the quadriceps(7).

Haemostasis must be done very accurately, in order to minimize bleeding which is quite significant. Examination of the leg flexion should be done with the hip in extension over the basin. If a flexion of 90 to100 is obtained, then it can be considered a successful intervention and then observe how the quadriceps lowers about 10-12cm. Only the skin is sutured with the knee in flexion, the muscle remaining at the level at which it had lowered. After applying the bandage, the leg is covered with a layer of wool, wrapped up in bud set, achieving as light compression on the thigh, following immobilization in pelvic-pediaplaster device with the thigh in extension over the basin with a flexion 90-100 on the thigh.



Fig. 7. Operatedcases of retraction of thequadriceps (personal archives).

Results

Postoperative results are mostly good or very good, especially in recent years, when the technique acquired an experimental and pathophysiological basis and was used as a treatment by many specialists.

Criteria of these results are:

1. passive and active flexion-extension movementmeasuredbygoniometry;

2. study of quadriceps strength (determination of muscle functional capacity after Iordanescu Baciu clinical scale);
3. position of the patella and the presence of the patellar reflex ;
4. walking;
5. climbing and descending stairs;
6. running;
7. physical education program;

8. local aspect, postoperative scar, symmetry of the thighs;

Analysis of the results after the above mentioned criteria:

after the knee flexion (active and passive movements) the assesment is made with a clinical goniometer. After the degree of active flexion, the classification of the results on groups vary by author:

Judet for post- traumatic treatment of the knee:

Results	Degrees
excellent	over 100 ⁰
good	80-100 ⁰
satisfactory	50-80 ⁰
Very poor	Sub 50⁰

Pouliquenet al. for knee stiffness by R.I.C:

Results	Degrees
excellent	over 140 ⁰
good	up to 120 ⁰
moderate	up to 90⁰

Enasel for knee stiffness by R.I.C.

Results	Degrees
excellent	over 100 ⁰
good	80- 100 ⁰
moderate	under 80⁰

Our own interpretation after the following criteria:

Results	Degrees
excellent	over 110 ⁰
good	90- 110 ⁰
moderate	70- 90 ⁰
poor	under 70⁰

Results after active and passive flexions show:

Qualifier	Degree	No. Of cases	Percentage
excellent	>110 ⁰	22	37,28
good	90-110 ⁰	27	45,76
moderate	70-90 ⁰	8	13,55
poor	<70⁰	2	3,38

It is interesting to point out that, although, through surgery is achieved between 90-100 range of flexion (with the knee immobilized in plaster), afterwards the child will improve movement and increase the degree of flexion. This happens because the quadriceps' contractile element is enhanced, unlike adults, where, as Judet says, the flexion obtained at operation remains the same. I saw children who, at ckeck-up, had achieved a flexion of 140-160.

1. assesment of the quadriceps muscular functional capacity with the help of Iordanescu -Baciu clinical scale with gradations from 0-5. The results were as follows: 4-5= 41 cases; 3= 14 cases; 2= 4 cases.

This method asses, practically, the value of the lowered muscles. It was more difficult to use this method with

smaller children, even using the Spitzzy technique; judging by their active and passive flexion, one could suspect that they have a greater strenght.

2. patella as position and dimenssion was found normal in 54 de cases, 4 cases of upper outer dislocation and 1 case with permanent, complete external dislocation. Patellar reflex existent.

3. walking, was possible even for those who achieved a knee flexion of only 70⁰, without any abnormal element. This can be explained by keeping the iliac psoas, the tailor muscle and by the horizontal contribution of the adductors in the thigh flexion. Generally, for the extension of the calf, the quadriceps, with its renewed functional

capacity is strong enough to ensure a fairly reasonable walking

4. **running**, highlighted some deficiencies in the recovery of the hip flexion, due to the reinsertion of the tensor fascia lata and, sometimes, even of the tailor muscle, especially, in more serious conditions. Those children cannot raise their swinging leg rapidly, being aware that in running there's no double support. They run errantly, limping, throwing off their thigh.

5. **the sports and physical education program**, required in schools as a sum of the movements examined above, could be easily and correctly executed by the great majority of children, who had over 90° of flexion, quadriceps strength of a 4-5, except for the serious conditions.

6. **postoperative scar** was found in 16 out of 59 cases, partially with a keloid aspect, on the whole surface of the scar or only, partially. This keloid formation adds to the inestetical aspect of the thigh. It seems to develop very quickly, if we take into account that 3 scars were found in only 1 year after the surgery.

7. **thigh asymmetry** was constantly frequent, predominant in the unilateral cases, but also present in the bilateral ones, in which the injuries were never equal as surface or gravity.

Conclusions

1. The iatrogenic retraction of the quadriceps is a disease described in pediatric orthopedics, whose frequency and severity make it widely known. The iatrogenic etiopathogeny cannot be wrong. A careful and rigorous anamnesis, as well as the clinical examination of hips showed the existence, in the past, of prolonged injectable treatments. We can't blame those treatments because they have saved thousands of lives. But, if today we know that by injecting drugs in the thigh a series of compartmentalized syndromes are achieved, whose purpose is the retraction of the quadriceps in extension of the knee, we must do everything for preventing it.

2. The histo-pathological lesions observed in both biopsies collected after surgery, as well as during the experimental research have clearly showed the fibro sclerotic transformation of the muscle tissue, with the loss of mobile, contractile parts. The clinical correspondent of the quadriceps sclerosis is represented precisely by the knee

biomechanics effect, stiffness in extension with or without patellar dislocation.

3. There are no problems of positive and differential diagnostic, to the extent in which the examiner knows the problem. This way, children are operated and explored by knee surgery (because there is suspected obstruction), or are recommended physical therapy (useless in the established disease stage). Therefore, we believe it is useful to inform the pediatric and orthopedic network about the disease.

4. The evolution of the disease is progressive up to a certain level where flexion is blocked, sometimes to the stage of genu recurvatum in very serious cases. The parents of such children should be advised not to wait more than 2-4 years to accept surgery because significant osteo-articular changes take place in the knee, and worsening of the quadriceps sclerosis that make the surgery and postoperative muscle re-education difficult.

5. The surgery is the only one capable of solving the disease. There are some surgeons in favour of lengthening the quadriceps tendon. Experience in the clinic shows that, in most of the cases this lengthening is not enough for obtaining a satisfactory flexion of the calf on the thigh and the postoperative rehabilitation can not recover completely the calf extension.

6. The Socolescu technique of extraperiosteal reinsertion and lowering of the quadriceps, which is associated with the reinsertion of tensor fascia lata and sometimes of the tailor muscle, answers all the criticism of other surgical methods and is adapted to the very local situations resulting from muscle fibrous retraction. In addition, by reinserting tensor fascia lata, external rotation is corrected. Plaster immobilization for 3-4 weeks followed by careful rehabilitation, assisted and directed, provides very good results. The complications of this postoperative technique, when it is well performed, when hemostasis is done with full attention and the aseptis is treated as the "the surgery's golden rule" are minimal.

7. It's important to underline that after surgery, through a sustained correction, the knee flexion increases in amplitude.

But the most important conclusion of this work remains the problem of the disease prophylaxis. The conjunction of all factors from the Ministry of Health is a necessary responsibility, until each person in the medical field is determined to do whatever it takes to avoid this iatrogenic disease seriously affecting small patients.

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