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The role of exercise in the postoperative rehabilitation of patients with Dupuytren's disease

Rolul efortului fizic în recuperarea postoperatorie a pacienților cu Boala Dupuytren

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Abstract

Background. Dupuytren's disease is a chronic idiopathic benign and proliferative disorder of the palmar and digital aponeurosis of the upper limbs, with progressive evolution, causing flexion contracture of the fingers. The disease predominantly manifests in the male sex, particularly after the age of 40. Early onset is an aggressive evolution marker, except for non-Dupuytren's disease, which can occur at any age and has a stationary evolution, depending on the action of the trauma. A number of sports branches such as rock climbing and athletics are predominantly affected, but the disease may also develop in other repetitive palmoplantar contact sports. Treatment can be topical, injectable or surgical for advanced cases with functional impotence. Rehabilitation has a demonstrated role in sports reintegration.

Aims. The aim of the study is to evidence risk groups for Dupuytren's disease, as well as prophylaxis, treatment and the role of post-treatment rehabilitation.

Methods. The article will attempt to delineate the cases occurring in patients; compared to Dupuytren's disease, which develops after the fourth decade of life, minimally invasive topical or injectable treatment is most frequently sufficient for stationary non-Dupuytren's disease cases.

Results. Physical overstrain of the hand was present in all patients showing disease extension, after surgical treatment. The only impact variables were the presence of family loading and advanced patient age, regarding the evolution towards recurrence of Dupuytren's disease.

Conclusions. Postoperative results concerning the functional recovery of patients with more severe forms of Dupuytren's disease are more favorable when physiokinesitherapy is associated.

Key words: Dupuytren's disease, non-Dupuytren's disease (NDD), exercise

Rezumat

Premize. Boala Dupuytren este o afecțiune idiopatică cronică, benignă și proliferativă a aponevrozei palmare și digitale a membrelor superioare, cu evoluție progresivă, determinând contractura în flexie a degetelor. Boala se manifestă cu precădere la genul masculin, fiind întâlnită mai ales după vârsta de 40 de ani. Debutul precoce este un marker de evoluție agresivă exceptând sindromul non-Dupuytren disease, care debutează la orice vârstă și are o evoluție staționară, dependentă de acțiunea traumei. Diferite ramuri sportive sunt afectate cu precădere, cum ar fi alpinismul, atletismul, dar ar putea apărea și la alte sporturi de contact repetitiv palmo-plantar. Tratamentul poate fi topic, injectabil sau chirurgical, pentru cazurile avansate cu impotență funcțională. Recuperarea are un aport demonstrat in reintegrarea sportivă.

Obiective. Obiectivul studiului este evidențierea unor grupe de risc pentru boala Dupuytren, profilaxia, tratamentul și aportul recuperării posttratament.

Metode. Articolul va încerca o delimitare a cazurilor apărute la pacienți; față de boala Dupuytren, care apare dupa decada a patra, tratamentul topic sau injectabil, minim invaziv este de cele mai multe ori suficient pentru cazurile staționare cu apartenență la sindromul non-Dupuytren's disease.

Rezultate. Suprasolicitatea fizică a mâinii a fost prezentă la toți pacienții prezentând extensia bolii, după cura chirurgicală. Singurele variabile de impact sunt prezența încărcăturii familiale și vârsta ridicată a pacienților, în ceea ce privește evoluția spre recurență a bolii Dupuytren.

Concluzii. Rezultatele postoperatorii în ceea ce privește recuperarea funcțională a pacienților cu forme mai severe de boală Dupuytren sunt mai favorabile prin asocierea fiziokinetoterapiei.

Cuvinte cheie: Dupuytren's disease, non-Dupuytren's disease (NDD), efort fizic.

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Introduction

Dupuytren's disease (DD) is a benign fibroproliferative disease affecting subcutaneous palmodigital tissue, which is responsible for nodules and cords, being accompanied in the long term by progressive retraction and flexion contracture, with the gradual loss of hand function. It is one of the most frequent fibromatoses with hereditary transmission. The development of plantar fibromatosis is an ectopic disease that is more common in athletes, as a result of injuries, repeated plantar trauma or overstrain of this region. A number of factors have been involved in the development of DD: the geographical area, patient gender, advanced age, family history, alcohol, smoking, physical overstrain, a history of trauma, high serum lipid levels and comorbidities such as diabetes mellitus, rheumatoid disease, epilepsy, liver cirrhosis, HIV/AIDS (Nicula, 2015).

Various sports have been incriminated in the acceleration of the disease, including rock climbing (Logan et al., 2005) and athletics (Heim et al., 1987), according to the same pattern of repeated trauma of the palmar fascia (Kirsch, 1975) and plantar fascia, respectively, or infectious inoculation as a trigger of the disease (Mandal & Fahmy, 2006). The disease may also occur in gymnasts, tennis players, weight lifters, cross-country skiers. A proportion of 19.5% of men who practiced rock climbing had pathognomonic DD lesions with an earlier onset compared to the general population (Logan et al., 2005). Recent studies consider DD to be a systemic connective tissue disease, characterized by subtle biochemical changes that generate ectopic fibrous deposits. The theory is based on the observation of an association of palmar contracture, with or without the involvement of proximal interphalangeal joints, with connective tissue accumulation in the elbow, sole, auricle and penis.

Although it is considered that the majority of patients are descendants of the Northern European population (Ross, 1999), general prevalence varies between 0.2-56% (Hindocha et al., 2009), depending on the geographical area. Prevalence also varies depending on racial groups; the disease is most frequent in the Caucasian race, less frequent in Afro-Americans, with similar disease characteristics, and most rare in Asian populations (Saboeiro et al., 2000). General prevalence in the Northern European population is over 17% (Seegenschmiedt, 2012), while in the North American population it is between 1-7.3% (Dibenedetti et al., 2011).

Onset age is 45-65 years, being higher in the female sex, a situation that is reversed in the Asian Chinese population, where Yeh et al. (2015) report a mean age of 53 years for women and 60 years for men. The disease prevalence is in a direct relation with advanced age, and early onset predisposes to a more severe and debilitating evolution. Although extremely rarely, studies have evidenced disease cases in children, before the age of 13 (Urban et al., 1996).

Regarding the influence of gender on the prevalence of the disease, this is more frequent in males (Hindocha et al., 2006), with a female/male ratio varying from 1/1.5 to over 1/10 (Lanting et al., 2013; Brouet, 1986) depending on the age group and geographical area, so that in the 8th decade of life, the ratio becomes 1:1.

Causes

a) Physical overstrain of the hand

Dupuytren was the first to report the association of the disease with professions that involve an overstrain of the hand. The best known counterargument was provided by Goyrand almost two centuries ago, which consisted of the development of bilateral disease in the case of a hospital manager (Goyrand, 1833). The controversy over the implication of cumulative work exposure seems to incline towards evidence of a dose-effect relationship (Degreef et al., 2008). In another study, both occupational exposure to vibrations and hard manual work without significant exposure to vibrations were associated with DD (Descatha et al., 2012). The presence of a vibratory overstrain of the hand associated with an increased incidence of the disease as well as with a dose-effect correlation is unanimously accepted (Palmer et al., 2014) .

b) Trauma

The first observations related to a possible risk of trauma for the development of DD were made by Hueston (1968) and Hart & Hooper (2005), who described the disease after a distal radius fracture. Other studies followed, some of which reporting algodystrophy as a cause, others immobilization of the hand as a treatment for trauma (Livingstone & Field, 1999). There is currently no consensus about the importance of these factors in the etiology of Dupuytren's disease (Klingenberg & Boeckstyns, 2011), or the presence of a single trauma.

In some Eastern European countries, the disorder is considered to be an occupational disease (Brenner & Krause-Bergmann 2001), while in others, it is not correlated with manual work or hand trauma (McFarlane, 1991). However, there is general consensus about the fact that one lesion cannot cause the disease, but may precipitate the unfavorable evolution of genetically predisposed individuals.

Diagnosis

McFarlane proposed a number of criteria for the diagnosis of DD, secondary to trauma (McFarlane & Shum, 1990):

1. The first presentation to the doctor before the age of 40 in men and 50 in women.
2. Bilateral disease occurring in patients without hand trauma, before the age of 40 in men and 50 in women.
3. Objective signs of hand trauma.
4. Disease evolution predominantly in the area affected by the trauma.
5. Development of the disease within 2 years of trauma.

From a *clinical* point of view, the disease presents the following types of elements, with progressive chronological development (McFarlane, 1974):

Dupuytren's nodules, McFarlane (cited by Khashan et al., 2011), (von Campe et al., 2012)

Skin umbilication

Skin thickening

Flexion contractures

Cords

The types of cords found in Dupuytren's disease are multiple:

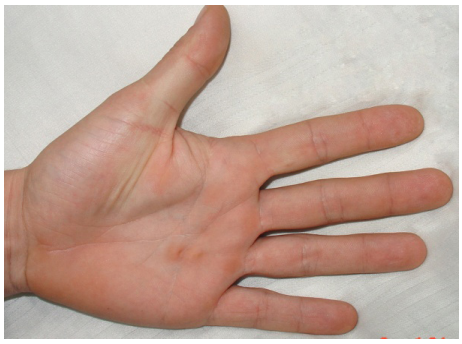
- *Pretendinous cord*

- *Spiral cord* (Umlas et al., 1994)
- *Natatory cord* (McFarlane, 1990)
- *Central cord*
- *Lateral cord*
- *Fifth finger abductor cord* (Missfelder et al., 1990)
- *Retrovascular cord*
- *Distal and proximal commissural cords* (McFarlane, 1985)
- *Thumb pretendinous cord*

In the fingers, the most frequently found cords are central, spiral and lateral ones. They are responsible for the distortion of proximal interphalangeal joints (Anderson et al., 1999).

More recent studies have demonstrated the presence of a different nosological DD entity, which, through the similarity of its clinical manifestations to the studied pathology, generates erroneous epidemiological results. The parallel entity to DD, generically termed non-Dupuytren's disease (NDD) (Rayan, 2005), can be differentiated from this based on the following characteristics:

- *ethnic distribution of the disease*: while DD occurs particularly in the Caucasian race, NDD can be found in a very wide range of ethnic groups;
- *uni/bilaterality*: if DD can develop bilaterally, NDD is characterized by unilaterality and in general, location in one finger;
- *etiology*: in general, NDD is most frequently associated with obvious trauma, while DD is characterized by a multifactorial mechanism;
- *treatment*: if in DD treatment is essentially surgical, NDD generally has self-limited forms, which require surgery only in exceptional cases (Fig. 1a, b).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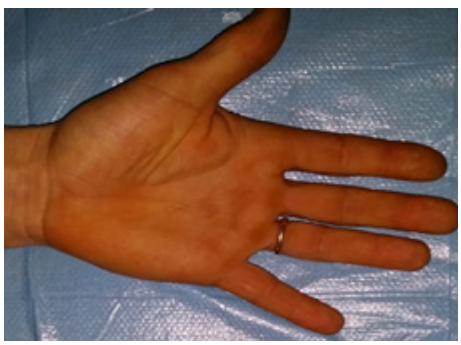
b

Fig. 1 – Typical nodular lesion in the fourth finger, developed unilaterally in a young patient aged 27 - non-Dupuytren's disease (NDD) - 10 years after superselective fasciectomy.

Selection criteria for treatment in Dupuytren's disease

1. Conservative treatment

In the case of patients with stationary DD, with minimal contracture without functional impairment, a wait-and-see approach and ambulatory monitoring are indicated.

Calcium channel blockers: nifedipine and verapamil can be indicated for early disease stages (Rayan et al., 1996), while clostridial collagenase is indicated for advanced stages (Peimer et al., 2015).

Another disease suppression method consists of intranodular steroid injections (Ketchum & Donahue, 2000) .

Other authors recommend intralesional interferon γ injections, which are attributed a role in improving symptoms and reducing lesion size both in DD and hypertrophic scars.

2. Surgical treatment

It is the therapeutic method of choice in the case of advanced stage DD. A flexion contracture of the metacarpophalangeal joint greater than 30° and of the proximal interphalangeal joint greater than 15-20° represents a treatment indication, particularly when associated with the presence of a prominent cord.

a) Subcutaneous fasciotomy (Crean et al., 2011; Smith, 2014; Henry, 2014; Pess et al. 2012; Corradino et al., 2013; Hovius et al., 2015)

b) Fasciectomies

- *Limited fasciectomy* (McFarlane, 1995) (Fig. 2a,b,c)
- *Limited selective fasciectomy* (Goyrand, 1834)
- *Segmental fasciectomy* (Degreef, 2011)
- *Complete or total fasciectomy* (McIndoe & Beare, 1958)

The open palm technique - Mc Cash (Guilhen et al., 2014) described the technique, with transverse incisions at the level of the flexion folds, partial aponeurectomy, healing *per secundam*.

- *Dermofasciectomy* (Henry, 2014)

c) Immobilization in extension (Isel & Celerier, 2010).

d) The continuous elongation technique (TEC) using the TEC device for severe Dupuytren's contracture of the fingers (Messina & Messina, 1993; Beyermann et al., 2002)

e) Salvage procedures, Moberg (1973) cited by Isel & Celerier (2010), (Werker, 2012)

f) Amputation (Degreef & De Smet, 2009)

g) Wound closure

The postoperative rehabilitation of patients with Dupuytren's disease. The role of rehabilitation treatment

Occupational therapy along with physiotherapeutic support makes postoperative rehabilitation possible in the majority of the cases.

The most frequent postoperative complications are joint stiffness and loss of preoperative flexion and extension. Although there are no methods to prevent or limit disease progression, nocturnal extension orthoses and regular physiotherapeutic exercises are useful in the postoperative rehabilitation period (Bayat & Mc Grouther, 2006).

The general principles of postoperative care for DD disease are the following: the patient is examined the next

a b c

Fig. 2 – Patient with simultaneous involvement of the fourth and fifth fingers and fourth finger contracture, visible during abduction of the fingers. Images during preoperative and intraoperative examination.

day, in dorsal decubitus, in order to control anxiety and possible triggering of vasovagal reflexes. If the dressing is adherent to the wound, physiological serum or sterile water is applied abundantly, and after 5-10 minutes the dressing is carefully detached, and potential drains are removed. After the wound dries, several days postoperatively, petroleum jelly or antibiotic ointments can be applied. Mupirocin ointment is preferred to other ointments due to the low incidence of allergic contact dermatitis (Sheth & Weitzul, 2008). The wounds are redressed with gauze compresses and the fingers are dressed individually, then they are conformed into an antebrachio-manual orthosis in neutral position, with a metacarpophalangeal joint flexion of 35-45° and relative finger extension. Only the operated fingers will be immobilized in the orthosis, if possible.

After a day, the patient returns for wound care and initiation of early mobilization, with progressive exercises. At this point, the hand can be washed in the sink with a mild hypoallergenic soap, then the wound is disinfected and dressed as before. The patient is instructed to execute active flexions within the limits of the orthosis; however, as a general rule, if pain increases as the session progresses, this means that the exercises have exceeded the physiological threshold.

During postoperative weeks 2-3, flexion-extension exercises are performed progressively; the therapist starts with passive movements of the proximal interphalangeal and distal interphalangeal joints, with axial traction. These can be performed with volar finger splints, up to 4-5 times per day, for maximum 15 minutes. Electrostimulation can be used for neuromuscular reeducation and stimulation of tendon gliding. Starting with week 3, it can also be applied to extension, with the blockage of the metacarpophalangeal joint and the exclusive stimulation of the joint.

The sutures are removed after at least 2 weeks, unless intolerance or local infection develops, in order to prevent wound dehiscence. They can be maintained for 3 weeks in diabetic patients. After the sutures are removed, the scar can be covered with a longitudinal protection band, along the tension lines, which can be changed after shower. If the scar is extremely sensitive or hypertrophic, silicone bands can be applied directly to the scar during the night (Davis & Eaton, 2012).

Immobilization is discontinuous during the third week, and the nocturnal orthosis is replaced with a volar device that immobilizes the proximal interphalangeal and the distal interphalangeal joints (Isel & Celerier, 2010).

Hypothesis

Efficiency of postoperative recovery treatment in the functional rehabilitation of the hand, by using physiokinesitherapeutic procedures consisting of immobilization in extension alternating with passive and active physical exercises.

Material and methods

Research was performed with the patients' informed consent and with the approval of the Ethics Committees of the health care units where the studied patients were diagnosed and treated.

Research protocol

a) Period and place of the research

The study included 69 male subjects, with a mean age of 57.87 ± 1.8 years, who underwent surgical treatment for DD.

b) Subjects and groups

The subjects participating in the research presented to the following health care units: Surgical Clinic I, Military Hospital Cluj-Napoca, Clinic of Diabetes and Nutritional Diseases, Interservisan Clinic, Chişineu-Criş City Hospital, in the period 01.01.2004-31.12.2007, and were diagnosed with DD.

c) Tests applied

Diagnosis was made based on the following criteria: pathognomonic DD lesions, with the appearance of pathological processes by well defined anatomical pathways in the palmar aponeurosis, along longitudinal tension lines. The main affected structure was the fan-shaped insertion of the long palmar muscle or, in its absence, the palmar fascia joined with the deep antebrachial fascia, or the flexor volar retinaculum.

d) Statistical processing

Multivariate analysis and analysis of factors associated with disease extension.

Results

a) Analysis of factors associated with disease extension in the studied group

It shows that physical overstrain of the hand was present in all patients with disease extension after surgical treatment. In contrast, patients with a favorable local evolution reported physical overstrain of the hand only in 33.84% of the cases (22 patients). This factor was demonstrated to be a significant risk factor through

the following parameters: OR=9.7; 95%CI=1.0-88.9%, p=0.0173 (where OR is *odds ratio* and CI is *confidence interval* (Tables I & II).

Table I
Physical overstrain of the hand.

Physical overstrain of the hand	Extension present	Extension absent	Total	p
Present	4	22	26	0.0173
Absent	0	43	43	Re
Total	4	65	69	15.38%

Interestingly, vibratory overstrain was absent in patients with DD extension after treatment, patients reporting only mechanical overstrain of other nature. In the group of patients with favorable local evolution who reported an overstrain of the hand, this was vibratory in 10.3% of the cases, and of other causes in 89.7% of the cases.

Upper limb trauma were not validated as a risk factor in univariate analysis, being absent in the group with post-treatment DD extension and present in 10.8% of the cases in the group with favorable evolution (OR=0.9; 95%CI=0.9-1.8, p=0.489) (Table II).

Table II
Results of univariate analysis of possible factors involved in DD extension after surgical treatment.

Indicators	OR	95%CI	p
Gender (M)	1.50	0.10-15.5	0.425
Age	–	–	0.010
Environment (rural)	14.70	1.40-15.5	0.0255
Family history	0.70	0.07-7.70	1.000
Amount of alcohol	–	–	0.000
Smoking	0.35	0.05-2.71	0.303
Physical overstrain of the hand	9.70	1.00-88.9	0.0173
Upper limb trauma	0.90	0.90-1.80	0.489
Diabetes mellitus	0.90	0.90-1.01	0.4908
Hypercholesterolemia	1.60	0.20-12.10	0.646
Hypertriglyceridemia	1.70	0.20-12.9	0.600
Bilateral disease	16.50	1.50-17.9	0.0202
Degree of involvement	–	–	0.287
Type of surgical treatment	–	–	0.929
Extension of surgical treatment	–	–	0.091

b) Multivariate analysis

A multiple logistic regression model was developed by inclusion of the following variables: age, environment of origin, daily amount of alcohol consumed, physical overstrain of the hand, bilateral disease. Following analysis, rural environment and bilateral disease were considered as independent predictive factors (Table III).

Table III
Results of multivariate analysis of risk factors for DD extension after surgical treatment.

Indicator	p	OR	95.0%CI for OR	
			Lower	Upper
Age	0.400	1.15	0.83	1.60
Environment (1)	0.002	3.73	1.08	3.86
Alcohol consumption	0.145	1.04	0.99	1.10
Overstrain (0)	0.997	0.00	0.00	1.01
Bilateral disease (0)	0.027	2.17	1.01	2.95

c) Analysis of factors associated with disease recurrence in the studied group

Post-treatment, *physical overstrain of the hand* was present in symmetrical proportions in the group of patients with DD recurrence (62.5%) and in the group without this evolution pattern (59.0%). The risk potential of the factor was denied by the results obtained following analysis: OR=1.157, 95%CI=0.2533-5.289, p=0.8736 (Table IV).

Table IV
Physical overstrain of the hand.

Physical overstrain of the hand	Recurrence present	Recurrence absent	Total	p
Present	5	36	41	0.8736
Absent	3	25	28	*Re*
Total	8	61	69	12.20%

Also, the figures did not demonstrate an additional risk impact for vibratory overstrain of the hand (OR=0.8, 95%CI=0.8-1.9, p=0.586) in the development of recurrence after surgical treatment.

A history of trauma was reported by 2 patients in the group with DD recurrence (25%). In contrast, the group without this unfavorable evolution pattern in the long term reported the presence of trauma in a proportion of 8.19% (5 patients). However, differences did not reach the statistical significance threshold required for validation as a risk factor for DD recurrence after surgical treatment (OR=3.7, 95%CI=0.6-23.6, p=0.139).

All univariate analyses were centralized in Table V.

The figures show that the only impact variables are the presence of family loading and advanced patient age.

Table V
Results of univariate analysis of possible factors involved in the development of DD recurrence after surgical treatment.

Indicator	OR	95%CI	p
Gender (M)	0.3889	0.07-2.31	0.341
Age	–	–	0.043
Environment	2.085	0.2361-18.42	0.5666
Family history	16.72	1.917-145.9	0.003
Amount of alcohol	–	–	0.213
Smoking	0.5926	0.1269-2.7666	0.5221
Physical overstrain of the hand	1.157	0.2533-5.289	0.8736
Upper limb trauma	3.7	0.6-23.6	0.586
Diabetes mellitus	1.926	0.3348-11.08	0.4842
Hypercholesterolemia	0.5	0.1-2.6	0.384
Hypertriglyceridemia	0.5	0.1-2.7	0.783
Bilateral disease	0.864	0.1891-3.948	0.8736
Degree of involvement	–	–	0.261
Type of surgical treatment	–	–	0.523
Extension of surgical treatment	–	–	0.389

d) Multivariate analysis after surgical treatment

A multiple logistic regression model was built, which included the following variables: gender, age, environment of origin, family history, physical overstrain of the hand, bilateral disease. As shown in Table VI, the only factor with independent risk power was family history (Table VI).

Table VI
Results of multivariate analysis of risk factors for recurrence of Dupuytren's disease after surgical treatment.

Indicator	p	OR	95%CI for OR	
			Lower	Upper
Gender	0.295	0.33	0.04	2.66
Age	0.626	0.98	0.91	1.06
Environment	0.526	2.11	0.21	20.97
Family history	0.006	3.58	2.78	463.88
Overstrain	0.969	1.00	0.19	5.38
Bilateral disease	0.827	1.25	0.21	7.42

Discussions

Sports that involve repeated trauma of the palmodigital aponeurosis with sufficient rhythmicity can cause the development of DD specific lesions. These are more frequently NDD (non-Dupuytren's disease) lesions with earlier onset, evolution depending on persistence of the trauma, limited and efficient treatment (topical, injectable and rarely surgical). Repeated trauma found in certain sports are responsible for the higher prevalence and earlier onset of some NDD forms.

Unfavorable evolution manifesting by post-surgical DD extension is a subject that is little addressed in the literature. Our results suggest the presence of a risk pattern based on two elements:

a) A rural environment of origin. This risk factor, demonstrated as being independent, induces overexpression of other risk factors such as: intense use of the hands in daily physical activities, with their overstrain including after treatment, non-compliance with treatment. Within the limits of the small number of patients in whom post-surgical disease extension could be demonstrated, the results evidenced even higher degrees of involvement of the right hand, as the preferentially used limb. In the studied group, a more frequent involvement of the right hand was observed, 60% of the cases presenting specific DD lesions in the right hand.

b) Bilateral involvement as a severity marker suggests the impact of the genetic and/or molecular pattern of the disease in parallel to the impact of environmental and behavioral factors. Bilateral disease in the studied group was seen in 51.11% of all patients, with a slightly higher frequency in men. Some authors obtained relatively similar results. Hindocha et al. (2006) observed a 47% frequency of bilateral involvement in patients with DD recurrence, while Loos et al. (2007) found bilateral disease in 45.8% of patients (Fig. 3 a, b).

The environment of origin - rural, a family history of DD and physical overstrain of the hand were considered significant risk factors.

In a subsequent study, overstrain of the hand was found in 15 of the 21 studied patients, representing 71.42% of cases, and trauma were described in 5 patients, representing 23.80% of all cases. Physical overstrain of the hand was associated with progressive DD evolution after surgical treatment in 6 cases, representing 28.57% of operated cases with unfavorable evolution.

Five patients, representing 23.80%, had repeated trauma of the affected hand, most frequently caused by daily activities. Only 2 patients, representing 40% of patients with repeated trauma, had a progressive evolution of lesions after surgical treatment.

Pareto analysis of favoring extrinsic factors present in the preoperative period in patients with DD who underwent surgery and were followed up in the medium and long term postoperatively showed that alcohol consumption, smoking and overstrain of the hand represented over 80% of these factors.

The higher recurrence rates for the right hand can be explained by the high proportion of persons with a dominant right hand.

Although a great number of patients had risk factors for DD – chronic smokers, chronic alcohol consumers, physical overstrain of the hand, and they continued the same lifestyle postoperatively, it was observed that the presence of one or two risk factors did not significantly influence the development of recurrence or disease extension. The concomitant presence of 4 risk factors was associated with the development of recurrence after surgery.

a

b

Fig. 3 – Patient with bilateral involvement of the fifth finger and flexion contracture of 100° and 50°, respectively.

The role of physical exercise in rehabilitation

Active movements

Since the first postoperative visit, the patient is asked to make gentle, active movements with the fingers. The physical exercises used as part of postoperative rehabilitation are as follows:

1. blockage of the finger:
   a) active flexion of the proximal interphalangeal joint while maintaining the metacarpophalangeal joint in extension;
   b) active flexion of the distal interphalangeal joint while maintaining the metacarpophalangeal and proximal interphalangeal joints in extension;
2. active flexion of each finger up to the thenar eminence level;
3. active flexion of each proximal interphalangeal joint up to the palm level while maintaining all the other fingers in extension;
4. closing the fist;
5. abduction and adduction of the fingers;

6. extension of the fingers:
   a) active extension of the metacarpophalangeal joint;
   b) active extension of the proximal interphalangeal joint by maintaining the metacarpophalangeal joint in hyperflexion, using the unaffected hand;
7. complete movement of the wrist and thumb.

The exercise program usually comprises 10 repetitions of each exercise 3-4 times a day. This program can be adjusted; a smaller number of repetitions can be recommended for certain patients. Severe flexion contractures of the proximal interphalangeal joint of the small finger sometimes lead to compensatory hyperextension of the distal interphalangeal joint. For surgical correction of this type of contractures, proximal interphalangeal joint extension can be used, by fixation with Kirschner pins. Early mobilization in flexion of the distal interphalangeal joint will play an important role in restoring tendon gliding and realigning segments (Fiettti & Mackin, 1995).

As movement improves, exercises will change, acquiring a higher degree of precision. Usually at about 2 postoperative weeks, exercises favoring tendon gliding can already be initiated. These optimize the movement of the flexor tendon and implicitly, joint movement.

Active use of the hand is encouraged by occupational therapy. Even when the wound is still open, prehension movements of the fingers can be initiated. Following wound closure, 4 weeks after performance of the open palm technique or at 2-3 weeks, after primary suture, sustained exercises for strengthening palmar structures by flexion-extension movements are progressively added to the physiotherapy program. In patients with skin grafts, these types of exercises are added only when the degree of local scar formation allows it. These exercises are recommended in at least 5 sessions with 15-20 repetitions (Davis & Eaton, 2012).

Physical overstrain will be avoided, because it can generate pain and edema. Movement resistance will also increase progressively, with the increase of tolerance (Salvo, 2014).

Passive movements

For joint stiffness or limitation of active tendon movements, gentle passive movements can be included in the physiotherapy program to maintain joint mobility. If the passive flexion of one or several proximal interphalangeal joints is limited, gentle orthosis immobilization can be required. The orthosis is applied on the volar side, to the proximal interphalangeal joints and the metacarpophalangeal joints. The patient will be encouraged to adjust tension in the orthosis until traction of the affected joints is felt. Residual contractures after percutaneous fasciotomy can respond favorably to nocturnal splint immobilization, according to Meinel (Meinel, 2012).

A number of physiotherapy techniques have been designed to improve postoperative flexion and extension, including the use of an elastic band, which maintains both categories of joints in a flexed position under slight tension. Patients must be instructed throughout the physiotherapy program to correctly use movements and immobilization means. Patients will be explained how to watch for color changes in the finger pulp, exacerbation of edema and development of paresthesia, in which case they will have to reduce orthosis tension (Walsh, 2011).

Management of the postoperative wound

After wound healing, lanoline massage to hydrate the scar and maintain its mobility has proved useful. Other excipients, including onion extract gel, or hot compresses have also demonstrated their efficiency. Massage of the palms and fingers is performed before each physical exercise session. Movements will be rhythmic, circular, similar to gentle taps along the scar.

For scar management, silicone gel or patches applied along the scar, sealing it and causing compression, are currently used. Their advantage is due to the plastic properties of silicone, which allows to obtain a cast with constant pressure on all scar areas. If additional pressure is required, a palmar orthosis will also be applied over the elastomer. If the scars are dull, non-reactive, the elastomer will be removed. For patients with occupations that involve manual work, changing the workplace or discontinuing work for at least 3-4 months and occupational therapy are recommended (Walsh, 2011).

Physiotherapy methods

Physiotherapy, using hot or cold procedures, is useful in the postoperative treatment of patients with DD. Heat applied as packs, fluid therapy or paraffin baths is useful in increasing scar and soft tissue extensibility and in reducing pain and functional impotence. Used before physical exercise, heat considerably improves the results of the efforts made by the patient. Used after physical exercise, hot packs can reduce pain and edema. Alternating baths have also proved their utility in edema and pain control. The technique of alternating baths involves immersion of the hand in cold water at temperatures of 12-18°C for one minute, followed by immersion in water at body temperature for 3 minutes. During water immersion, the patient is asked to squeeze a sponge, followed by extension of the fingers. This alternating sequence is repeated for 10 minutes, stimulating circulation and facilitating improvement of edema.

Conclusions

1. From a therapeutic point of view, limited partial fasciectomy remains the safest surgical procedure, with a low recurrence rate and risk of progressive evolution after therapy, for Dupuytren's disease forms.
2. The long-term postoperative results of the patients included in this study were satisfactory.
3. The long-term satisfaction of patients with DD treated by surgical methods is correlated with the favorable postoperative results.
4. Rehabilitation therapy as a component of multidisciplinary treatment can be effective in terms of quality and extension of functional recovery.

Conflicts of interests
No conflict of interests.

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