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Overuse Syndrome of Elbow and Forearm. Notation on the use of Tricompartimental Fasciotomy

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Summary

In this study, the author explains the Subcutaneous variant of surgery of "Three-compartiment Fasciotomy" (STF) used in chronic compartment syndrome of forearm and elbow, particularly in the Overuse Syndrome, that can be the result of repetitive muscular strains. The man's upper limb morphogenesis in phylogeny, adapted to the handling and use of instruments in various work activities, leads to consider a primary causal role of occupational factor (Overuse) in the development of "overload disorders". Overloading can also become cumulative in the course of normal business activities: in agriculture, in factories, in offices, at home, etc. An unrecognized overuse mode is vibration. For example, in professional riders or users of vibrating tools (percussion, rotation, etc.). In the compartment suffering, the pain is the dominant clinical symptom and often increases at night with neuralgia of the median, radial or ulnar nerves. Physical examination often shows an aspect of the forearm hypertrophy, similar to "Popeye". Medical therapy should be carried out right away, in addition to prevention, i.e., to break the vicious circle, we must block the pathogenic process and allow recovery. This requires, as a first step, the suspension of all physical activities with correction of predisposing factors. The first approach is thus conservative with set-aside of upper limb of the patients with guardians, and prescription of drugs as FANS, anti-edematous, vitamins, antioxidants; in some cases also cortisone orally or for infiltration and physiotherapy treatments. Surgical treatment by Tricompartimental Fasciotomy (TF) is recommended in compartmental symptoms with nervous suffering. The TF main indications are: tenderness on palpation simultaneously present epitrochlear and epicondylus and EMG positive for pain of median and/or ulnar nerves. The use of TF considers that the antebrachial fascia covers the three compartments of the forearm. With this anatomy it is not possible to unpack all the compartments with a single cut through the antebrachial fascia on the ulnar margin, detaching the muscles at the sides. In 2009, we turned the TF in subcutaneous, with two mini incisions: one, of 3 cm, free the ulnar cubital tunnel; the other is centered 1.5 cm distally to the olecranon. Decompression is achieved with myo-fascial shutdown via a periostotomo slid to the sides and on the ulnar crest, through the skin incision. This process significantly improves patient compliance and recovery time. Our results were positive, with over 95% of successes.

Key Words

Overuse syndromes, Elbow's overuse syndrome, Golfer's elbow, Lateral tennis elbow, Compartmental chronic syndrome, Tricompartimental Fasciotomy.

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Introduction

The elbow is one of the most useful but complex joints in the body. In a vision that combines phylogenesis and comparative anatomy, it can be asserted that its position between shoulder and wrist, its remarkable congruence and stability, the wide range of flexion-extension (0°–150°) and pronounced supination (75°- 0°–85°), which gives the upper limb a great versatility of movements, is the result of the evolutionary process that led from the Reptiles to the Primates. So, in the brachiation process, the joint is

completely emancipated from walking and it is finalized in the prehensile role of the hand. With the descent from the trees, the arboreal characteristics of the elbow have not been lost, but usefully retrained to carry out the many occupational activities of the upper limb, recreational-sports and / or work, typical of Man. All this allows us to understand the fundamental causal role played by the occupational factor (Occupational Overuse Syndrome) in all the so-called elbow and forearm overuse pathologies.

Definition of occupational overuse pathologies - Overuse Syndrome (OS)

The generic term of OS refers to a series of various and multifocal symptomatic manifestations, mostly painful, caused by mechanical stresses related to the performance of work, domestic or recreational, or sports activities (Fry, 1988). OS can affect any part of the body with tenomuscular structures. However, it is prevalent in the appendicular segments with higher incidence in the upper limb and in the shoulder girdle. The symptoms of OS have varying severity, in an acute, sub-acute or chronic form based on the history of the stresses and the occurrence of cumulative damage, more or less conditioned by any metabolic-constitutional meiopragia including: diabetes, chronic anemia, hormonal changes, dysvitaminosis, liver disease, broncho-pneumopathies, alcoholism, drug addiction, rheumopathies, all diseases exchange, etc. In Italian literature, there are several terms that define this pathology: from repeated efforts, from biomechanical overload of the upper limb; occupational syndromes, from hand-arm vibration, from hyperuse, metatraumatic of peripheral nerves, etc. (Assessorato Sanità Regione Piemonte, 1977; Rubino & Pettinati, 1994; Atti 58° Congr. Naz. SIMILI, 1995). In anglophone literature, they are: WMSD (Work related Musculo- Scheletal Disorders); RSI (Repetitive Strain Injury); RMI (Repetetive Movement Injury); CTD (Cumulative Trauma Disorders); OCD (Occupational Cervico-Brachial Diseases); OOS (Occupational Overuse Syndrome), etc., (Kroemer & Grandjean, 1998; Putz-Anderson, 1988; Yassi, 1997).

The maximum incidence occurs in manual workers, athletes, musicians, etc. representing about 56% of all occupational diseases (15–20% of workers in the USA). In other diseases the repeated muscle-tendon activity exhausts the reconstitutive capacity of the tissues (tendons, muscles, ligaments, etc.) which show acute local damage of a phlogistic type. In chronic exercise the cumulative damage tends to extend to the neighboring structures compromising the microcirculation of one or all the compartments (already not very extensible normally) of the segment concerned, with a hypertensive interstitial sub-edema which, due to further repair phenomena, stabilizes up to cause thickening and retraction of the connective tissue and a further increase in voltage, etc. In the forearm, this condition can lead to the onset of a chronic compartment syndrome, with possible associated nerve damage. With regard to biochemical damage, a relationship has been identified between increased tissue pressure and hyper-production of free radicals capable of activating inflammation (Withesides et al., 1975; Qvarfordt et al., 1983; Detmer et al., 1985; Abraham, 1979; Feldman et al., 1983; Grippi et al., 1997; Pedowitz & Toutonughi, 1988; Wasilewski & Ardourion, 1991; Söderberg, 1996; Rempel et al., 1992).

Clinical Generalities

In the upper limb, chronic pain is the most common of the symptoms of OVS, sometimes with a clear dysesthetic-neuralgic component. Its topography is not always well defined. A multi-focal origin can happen very often with “emerging” clinical manifestations differently characterized according to the starting tissue and / or related to the specific occupational history. In this regard, for example, it is easy to meet individuals who after suffering from epicondylitis or de Quervain's Syndrome also manifest Carpal Tunnel Syndrome (CTS). Or that at the same time or in variable succession present acromion-humeral conflict, epicondyle-epitrocleitis, CTS or other anti-brachiocarpal tendinopathies. Or, after being operated on for CTS,-compression of the ulnar at the elbow or cramp of the scribe or a cervical-scapular tension syndrome or rupture of the rotator cuff, etc. appear. The forearm and the elbow, however, are affected because they are involved in every manual activity and they are crossed by long nerves (radial, median and ulnar) forced into numerous anatomical constrictions (often close to the skeleton) and with several long-tendon muscles, distributed in two regions (one anterior or flexor and the other posterior or extensor) separated by the interosseous membrane. It is important to underline that the antibrachial aponoevrosis, inserting itself on the two sides of the dorsal edge of the ulna, covers these two regions like a sleeve. In the space between this and the interosseous membrane, the muscles are distributed in three distinct compartments up to the elbow: anterior, lateral and posterior.

Figure 1. The Strecting Test consists in the stretching maneuver of the anti-brachial muscles obtained by the forced passive hyperextension of the hand and wrist. The test is positive if the pain felt is associated with an appreciable contractural retraction, easily detectable by comparing the healthy contralateral limb.

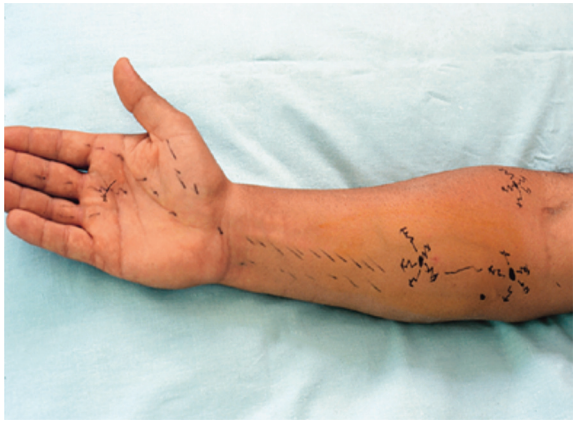

Figure 2. In the typical pan-compartmental forearm chronic suffering from functional over-use (Occupational Overuse Syndrome) pain, felt in the marked points and almost always associated with neural dysesthesia, dominates the clinical scene, making the forearm looks like “Popeye”.

The suffering of the volar anterior compartment tends to manifest itself, with the myalgia of the flexors and/or pronators, with the symptoms of epitrocleitis (such as the golfer's elbow) and/or enthesitis of the fibrous laceration, sometimes with projective pain towards the shoulder. In this phase, the pain can be accentuated by stretching maneuvers on the affected muscle (Stretching test) (Grippi et al., 1997) (Fig. 1). This sign is often associated with a minimal contractual retraction, easily detectable by comparing the contralateral limb. The inspection often highlights a proximal hypertrophic aspect of the forearm (similar to "Popeye") (Fig. 2). Palpatory tension may be present on the entire compartment with positivity of the Tinel's sign and neuralgia from compression of the median nerve, (such as pronatory syndrome or CTS) not always associated with similar dysnesthesia of ulnar nerve, easily caused by the percussion of the nerve to the egress of the cubital canal.

The suffering of the lateral compartment (posterior-lateral), on the other hand, in addition to the inconstant myalgia of the extensors, easily reproduces the symptoms of classic epicondylitis (such as the tennis elbow in all evolutionary degrees). In addition, even if infrequently, it can manifest itself with dysesthesia and/or neuralgia of the two terminal branches of the radial nerve; extensor paralysis is exceptional (Posterior interosseous radial nerve syndrome). In some cases, there may also have been De Quervain's disease at the onset, etc.

Instead, the suffering of the posterior (dorsal) compartment is felt through elbow pain, typically evoked by the active hyperextension of the joint and elective at the palpation of the anconeus muscle, sometimes with projective and/or palpatory pain along the triceps brachialis. It can simulate and be confused with the symptoms of epicondylitis. Finally, in the far from rare case of the associated suffering of the three antibrachial compartments, the above symptoms overlap. Therefore, the elbow pain is characteristically on the epicondyle, the epitroclea and on the olecranic enthesis of the anconeus, possibly associated with projective pain on the shoulder stump and/or on the neck and/or on the pectoral muscle and, sometimes, with dysesthesia and/or neuralgia of the whole hand, as a glove. Very often, moreover, the electromyographic examination is CTS positivity and, possibly, associated with signs of suffering from the ulnar nerve to the cubital canal. We anticipate, that precisely in this symptomatic association, the intervention of Tricompartmental Fasciotomy is indicated.

The Elbow Overuse

From the above, it is not easy to distinguish the “exclusive” overload syndromes of the elbow. In clinical reality, pain generally tends to involve the entirety of the upper limb. However, for descriptive purposes, it is possible to identify "emerging" clinical ictures in the elbow due to specific occupational activities. In this regard, in Table 1 some sports activi-

ties commonly associated with functional over-load of the elbow are listed.

In addition to gyms, the same pathologies can, moreover, manifest themselves in the development of many common work activities: in agriculture, in factories, offices, in the home environment, etc. Furthermore, a particular type of functional overload is determined by the use of vibrating tools. And some of the aforementioned elbow pathologies can be traced back to this cause, such as the compressive pain of the ulnar, some bursitis, tendinitis and capsulous ligament calcific enthesitis and the triceps (the so-called beak and olecranon spur), early joint arthrosis, etc. (Fig. 3).

Some sources of exposure to vibrations of the hand-elbow-arm system, present in many sports and work activities, are listed in detail in Table 2.

Clinical Judgment

In the patient with elbow pain, the occupational history is fundamental. Information should be sought on professional and / or recreational activities at risk of overuse. The history of symptoms can be useful to identify the malicious activity and consequently the abused tissues. Severity can be judged by the relationship of symptoms with activity: after, with, or at rest. It is important to determine the location, characteristics, pain irradiation, aggravating factors and those that alleviate.

The physical examination includes inspection, palpation, movement tests, neurological assessment, etc., but keeping in mind that the overload may have damaged neighboring segments. Therefore, the neck, shoulder and wrist must also be examined - comparing with the counter-lateral limb - to exclude the elbow symptoms associated with dysfunctions of other sites. For example, the tennis elbow coexisting with the tendinopathy of the rotator cuff, or the pain of the median in the carpal tunnel, etc. However, Table 3 lists the causes of elbow pain in which it is legitimate to suspect in the first instance any functional overload, especially if the patient is an active worker.

Some tests should be routine:

The tennis elbow test is performed with the elbow extended, held still by the hand of the doctor with their thumb on the lateral epicondyle. The patient makes a fist, prone the forearm and extends the wrist, while the doctor applies a resistive force. The test is positive if pain occurs in the lateral epicondyle area. The ulnar and radial ligament stability are assessed with the forearm flexed at 20 degrees to release the olecranon from its fossa. The examiner alternatively examines in varus-valgus limb and com-

ACTIVITIES	RELATED PATHOLOGY
Bowling, Fencing	*Biceps tendonitis, radial tunnel syndrome*
Boxing	*Triceps tendonitis syndrome*
Football, basketball, and wrestling trauma	*Olecranon bursitis*
Golf	*Tennis elbow (epicondylitis), epitrocleitis (Golfer's elbow), radial tunnel syndrome*
Gym	*Biceps tendonitis, triceps tendonitis syndrome*
Hyperextension Efforts	*Postero-lateral rotational instability*
Racket and Throwing Sports	*Pronatory Syndrome, triceps tendonitis, olecranon-humeral conflict, olecranon stress fractures, chondromalacia of the radial capital, distractions of the ulnar collateral, tennis elbow, compression of the ulnar nerve*
Rowing	*Radial tunnel syndrome, carpal tunnel syndrome,*
Ski sport	*Ulnar nerve pain*
Swimming	*Radial tunnel syndrome*
Weightlifting	*Biceps tendonitis, radial tunnel syndrome, triceps tendonitis, anterior capsular distraction, compression of the ulnar nerve*
Motorcycling and cross	*Carpal tunnel syndrome, Suffering of ulnar nerve, acute or chronic suffering from the anti-brachial compartments (tri-compartmental syndrome).*

Table 1. Sports activities commonly associated with functional overload of the elbow.

IMPACT TYPE TOOLS	*Chisellers and scrapers, casting deburring, riveting hammers, removal of rust and paints, stone drilling hammers, electric, hydraulic, pneumatic, demolition hammers and construction pickers, hammer drills, screwdrivers, car bodywork, foundry sandblasting hammers, shears and nibbling machines for metals, artistic work and stone finishing, etc.*
ROTARY TOOLS	*Orbital and roto-orbital sanders, stone, wood, circular saws and jigsaws, angle and axial grinders, stone wood, agricultural-forestry chainsaws, brushcutters maintenance of green areas, etc.*
OTHER MACHINERY	*Lawn mower maintenance of green areas, rotary cultivators for agricultural and forestry work, palletts nailers, wood, vibro-concrete compactors, vibrated concrete production, flexible axis rotary shaping machines, artistic works, deburring, motorcycle handlebars finishing, dicing, stone working (porphyry), riveting machines for shoe factories, etc.*
COLUMN MOTOR MACHINES	*Dentist drills, dentistry, etc.*
OTHER VIBRATING MACHINES	*Motorbikes, tractors, tillers, brushcutters, trucks, pneumatic hammers, etc.*

Table 2. Exposure to vibrations of the hand-elbow-arm system present in many sports and work activities.

ANTERO-MEDIAL ELBOW pain	*Epitrocleitis (golfer's elbow), biceps tendonitis, anterior capsular distraction, medial collateral distraction, ulnar nerve pain, anterior compartmental pain*
ANTERO-LATERAL ELBOW pain	*Epicondylitis (tennis elbow), Radial tunnel syndrome, Chondromalacia radial capital, Posterolateral instability, Lateral compartmental suffering.*
POSTERIOR ELBOW pain	*Triceps tendonitis, Myocentitis of the anconeum, Olecranon-humeral conflict, Stress fracture of the olecranon, Olecranon bursitis, Posterior compartmental suffering.*

Table 3. Causes of elbow pain present in situation of functional overload.

pares it with the counter-lateral elbow. The "Apprehension test" is important, namely, the sensation of imminent dislocation, possibly felt by the patient.

The postero-rotational instability test evaluates the laxity of the ulnar part of the lateral collateral. If present, this instability allows the sub-dislocation of the humero-ulnar joint with secondary humero-radial dislocation. This test is best done with the patient in a supine position. The arm to be tested is extended back beyond the patient's head, and the shoulder is rotated externally. On the patient's forearm, the examiner simultaneously apply valgus stress, axial compression and elbow flexion. Apprehension and pain in the patient indicate a positive test.

The Stretching test (Grippi et al., 1997) (see Fig. 1) is carried out with the elbow extended and can be indicative of anterior and/or latero-posterior antibrachial compartment syndrome. It consists in the stretching maneuver of the anti-brachial muscles obtained by the forced hyperextension of the hand and wrist. The test is positive if the pain caused is associated with an appreciable contraction, easily detectable by comparing the healthy contralateral limb.

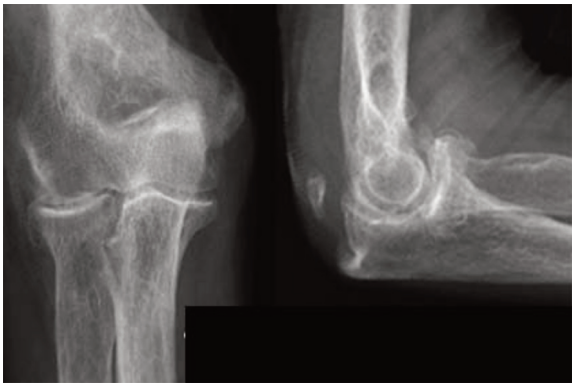

Figure 3. Olecranon beak, calcific biceps of the triceps, enthesitis of the collaterals and coronoid arthrosis osteophytosis of the radial capital and of the humeral trochlea in senior worker caused by jackhammer.

Principles of Treatment

Elbow and forearm overuse therapy must consider not only immediate improvement but also prevention. The modalities for acute pain are different from those for chronic symptoms.

In the acute phase, to interrupt the vicious circle, the pathogenetic process must be blocked to allow recovery of the patient. This requires, as a first act, the suspension of any pain-related physical activity with the identification and possible correction of predisposing factors and the use of appropriate drugs and/or physiotherapy treatments. The first therapeutic approach usually involves rest with the help of supports (wristbands, elbow pads etc.), abstaining from work, prescribing anti-inflammatory drugs, antiedema, vitamins C and E, mineral salts, L- acetylcarnitine, thioctic acid, in some cases also cortisone orally or by infiltration on the painful site (mainly in epicondylo-epitrocleitis and enthesitis) and, when imposed by laboratory tests, the possible use of other specialists: diabetologist, hematologist, endocrinologist, neurologist, rheumatologist, internist, etc. A useful physiokinesitherapy plan consists of two cycles of 10 physical therapy sessions with: high voltage TENS (Transcutaneous Electrical Nerve Stimulation), high power laser therapy, ultrasound and magnetotherapy.

Physiokinesitherapy is divided into 1 or 2 cycles of 10 sessions with manual stretching techniques, mobilizations, lymphatic drainage massage, deep connective tissue massage and muscle strengthening. Home cryotherapy (massage with ice bag for 20 minutes every 4 hours) and mesotherapy can be used for pain control. In some rare cases, rest may be forced by immobilizing the limb in periods of time ranging from 2 to 6 weeks.

Surgical approach

Usually, elbow and forearm overuse is considered an acute condition in which surgical treatment is not contemplated. On the other hand, chronic damage is treated in its various local symptomatic expressions, almost always without any reference to the initial cause and without considering any associated pathologies (e.g., epicondylitis surgery, nerve compression, etc.).

However, from our experience we believe that several chronic situations of compartmental overloading can usefully benefit from targeted surgery.

Surgical treatment is also recommended in patients with compartmental symptoms that show, from the beginning, signs of nervous pain (also highlighted with electomyography) and that do not obtain stable benefit after a conservative treatment period prolonged for 1–2 months.

In these patients, following the rationale that to improve tissue trophism the microcirculation space must be implemented, we practiced the fasciotomy of the suffering compartment, associated or not with the lysis of the tendons and symptomatic nerves, as below:

- Section of the fibrous tissue and proximal median fasciotomy; in case of epitroclear symptoms possibly associated with neurolysis of the median nerve if Electromyographic examination (EMG) positive for Cannal Tunnel Syndrome (CTS) and/or neurolysis of the ulnar nerve if EMG positive for pain in the cubital canal.

- Median fasciotomy at the 3° middle-proximal forearm; in case of symptoms on the flexors of the fingers possibly associated with the neurolysis of the median if EMG positive for CTS.

- Tricompartmental Fasciotomy (TF) in the presence (at least of the 1° and 2°) of the following criteria:

- 1. Muscular and/or aponeurotic pain on palpation simultaneously present in the epitrochlear, epicondyloid and/or anconeus muscle site.

- 2. Dysesthesia of the hand with eventual Tinel's sign positive (the sign that a nerve is irritated) and EMG indicative or in positive doubt for median and/or ulnar nerve pain.

- 3. Sensation of hard-elastic tension on palpation of the anti-brachial muscles.

- 4. Accentuated drawing of the venous network and/or hypertrophic aspect of the antibrachial muscle (similar to "Popeye").

- 5. Positivity of the Strecthing test.

In this regard, given the didactic nature of the present work, we limit ourselves to describing the surgical technique of Tricompartimental Fasciotomy (TF).

TRICOMPARTIMENTAL FASCIOTOMY (TF)

The TF utility (see Grippi, 2007, 2016) considers that the anti-brachial band covers the three compartments of the forearm with a sleeve, inserting itself on the sides of the ulna. With this anatomy it is possible to decompress all the compartments with a single retro-olecranon access, through which the anti-brachial fascia is sectioned along the edge of the ulna, detaching the muscles on the sides (Fig. 4).

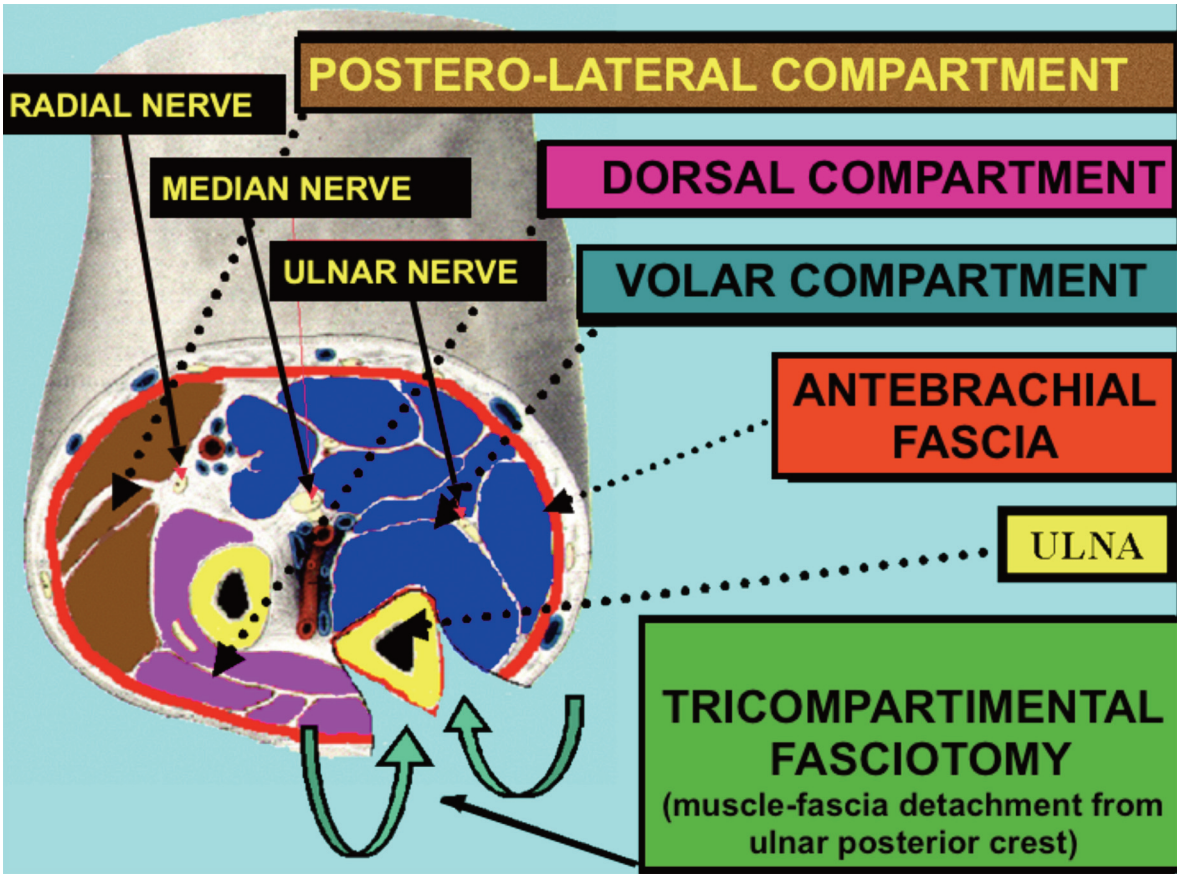

Figure 4. Tricompartmental Fasciotomy (TF), see text.

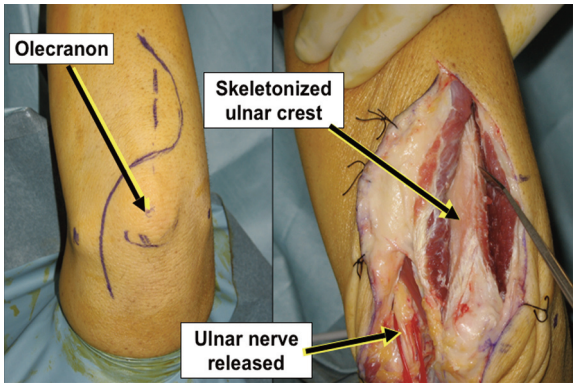

Figure 5. The original (open) surgical access (Grippi, 2007) ("Italic S") begins median behind the elbow, runs through the epitrocleo-olecranon shower and crosses the base of the olecranon curving towards the epicondyloids then falls obliquely on the posterior margin of the ulna and ends, at 10–15 cm from the olecranon, on the epitrochlear. Once the isolation and neurolysis of the ulnar have been carried out, continue with the section of the anti-brachial fascia on the sides of the ulnar crest. The muscles, respectively on the medial side the epitroclear and on the lateral side the anconeus and part of the epicondyloids, are disengaged with the periosteum detachment.

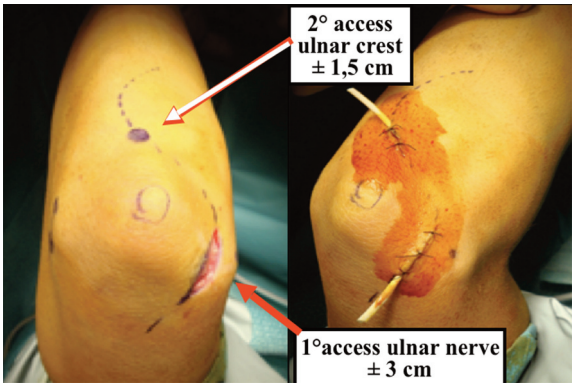

Figure 6. In subcutaneous surgery (mini-open), vice-versa (Grippi, 2016), two small incisions are made on segmental features of the "Italic S": the first, of 3 cm, across the cubital canal, allows the lysis of the ulnar; the second, of 1.5 cm, is centered on the ulnar crest distally the olecranon. Once on the bone, the tip of the scalpel is slid to the sides of the ulnar ridge so as to create a semicircular access breach below the insertion of the fascial plan. A small periostotome (0.8–1 cm wide) is cautiously introduced into it and is slid - well attached to the bone profile, along the ridge and to the two sides of the ulna - not less than 20 cm in the proximal-distal direction.

Figure 7. In sub-cutaneus surgery (mini-open), a small periostotome is slid under the skin on the sides and on the ulnar crest to detach the muscles and the fascia.

The surgery is performed under plexus anesthesia with the patient in a supine position. The limb, kept bloodless with a tourniquet, is positioned on the abdomen. The access to "Italic S", begins median behind the elbow, runs through the epitrocleo-olecranon area and crosses the base of the olecranon curving towards the epicondyloids then falls obliquely on the posterior margin of the ulna and ends, at 10–15 cm from the olecranon, on epitroclear. The small vessels coagulate, the skin is detached on the sides and the osteo-fascial plane highlighted. Once the cubital canal is opened, the ulnar nerve is isolated by carrying out careful neurolysis, up to the "Arcade of Struthers", continuing with the longitudinal incision of the antibrachial fascia along the ulnar crest, up to the bone. The muscles on the sides of the ulna and the olecranon are disconnected with the periosteum detachment.

Respectively, on the medial side the epitrocleari and on the lateral side the anconeus and part of the epicondyloids. At this point, due to the fascial detention, the spontaneous spread and protrusion of the dissected muscle flaps can be observed (Fig. 5). Finally, once the hemostatic fascia has been removed, the small muscle vessels are coagulated, a drainage is positioned and the ulnar nerve is released in its anatomical site, the wound is closed by suturing exclusively the skin and subcutaneous tissue.

At the end, a brachio-metacarpal soft bandage is made, and kept until the points are removed.

After this, the following is suggested: daily ablutions in warm salty water, centripetal lymphatic drainage massage (from the fingers to the elbow), active and passive mobilization. The progressive resumption of domestic activities occurs after the 3rd–4th week. The resumption of specific employment and/or work activities, after the 2nd month.

Then, in 2009 we turned the TF in subcutaneous (Grippi, 2016), with two mini incisions: one, of 3 cm, free the ulnar cubital tunnel; the other, of 1.5 cm, distal to the olecranon. Decompression is achieved with myofascial shutdown by a small periostotome slid to the sides and on the ulnar crest, through the skin incision. This procedure significantly improves patient compliance and recovery time (Figs. 6, 7)

Conclusions

Functional overload syndrome of the upper limb is a condition in many ways still unknown, though is affecting numerous patients. In the elbow, its acute "emergency" has been identified above all with reference to sport. The chronic pathology that mixes plurifocal nosological entities in the limb, often superimposed on each other, generally considered independent of each other but which certainly have a common triggering cause in occupational overuse, remains to be better defined, even if they undoubtedly influence factors of individual predisposition. However, exhaustive work, ergonomic planning and, also, the neglect of the health control workers of the occupational environments play a part.

Therefore, it is always useful to induce the patient to report the problem in their own context of activity. In any case, the physician is responsible for understanding and the treatment, even if in some cases recognized with chronic compartment symptoms, can also be surgical, through fasciotomy and neurolysis. Particularly in chronic cases with positive EMG for nervous pain, decompression interventions are needed. Among these, the option of TF (open or mini-open) was simple, with no contraindications and widely decisive.

References

Abraham W.M., 1979. Exercise-Induced Muscle Soreness. *The Physician and Sportsmedicine*, 7(10): 57–66. https://doi.org/10.1080/00913847.1979.11948 501

Assessorato Sanità Regione Piemonte, 1977. *Linee guida in materia di rischi da vibrazioni e da movimenti e sforzi ripetuti degli arti superiori*. Ed. G.S. & S., Grugliasco.

Atti 58° Congresso Nazionale SIMILI, 1995. *Le patologie dell'arto superiore da sovraccarico biomeccanico*. Bologna 11–14 ottobre 1995, vol. 1.

Detmer D.E., Sharpe K., Sufit R.L. & Girdley F.M., 1985. Chronic compartment syndrome: diagnosis, management, and outcomes. America Journal of Sports Medicine, 13: 162–170. https://doi.org/10.1177/036354658501300304

Feldman R.G., Goldman R. & Keyserling W.M., 1983. Classical syndromes in occupational medicine. Peripheral nerve entrapment syndromes and ergonomic factors. *American Journal of Industrial Medicine*, 4: 661–681. https://doi.org/10.1002/ajim.4700040508

Fry H.J.H., 1988. Overuse syndrome and its differential diagnosis. *Journal of Occupational Medicine*, 30: 966–967.

Grippi G.M., 2007. La fasciotomia tricompartimentale nella sindrome da sovraccarico funzionale cronico dell'avambraccio. *Rivista Italiana di Chirurgia della Mano*, 44: 1–11

Grippi G.M., 2016. La fasciotomia tricompartimentale sottocutanea (mini-open) nella sofferenza nervosa da over-use dell'avambraccio. *Rivista Italiana di Chirurgia della Mano*, 53: 33–41.

Grippi G.M., Peretti G. & Dettoni A., 1997. Sindrome compartimentale cronica della loggia anteriore dell'avambraccio. *Rivista Italiana di Chirurgia della Mano*, 34: 243–252.

Kroemer K.H.E. & Grandjean E., 1998. *Fitting the Task to the Human: A Textbook of Occupational Ergonomics, 5th edn*. Taylor & Francis, London, 416 pp.

Putz-Anderson V., 1988. *Cumulative trauma disorders: A manual for musculoskeletal diseases of the upper limbs*. Taylor & Francis, London-New York-Philadelphia, 168 pp.

Rubino G.F. & Pettinati L., 1994. *Patologia da sforzi ripetuti*. C.T.S.7 - Atti Giornata di Studio ad hoc. Torino 23 giugno 1994, Assessorato Sanità Regione Piemonte.

Qvarfordt P., Christenson J.T., Eklöf B., Ohlin P. & Saltin B., 1983. Intramuscular pressure, muscle blood flow, and skeletal muscle metabolism in chronic anterior tibial compartment syndrome. *Clinical Orthopaedics and Related Research*, 179: 284–290.

Pedowitz R.A. & Toutounghi F.M., 1988. Chronic exertional compartment syndrome of the forearm flexor muscles. *Journal of Hand Surgery (American Volume)*, 13: 694–696. https://doi.org/10.1016/s0363-5023(88)80126-6

Rempel D.M., Harrison R.J. & Barnhart S., 1992. Work-related cumulative trauma disorders of the upper extremity. *Journal of the American Medical Association*, 267: 838–842.

Söderberg T.A., 1996. Bilateral chronic compartment syndrome in the forearm and the hand. *Journal of Bone & Joint Surgery*, 78: 780–782.

Wasilewski S.A. & Ardourion P.L., 1991. Bilateral

chronic exertional compartment syndromes of forearm in an adolescent athlete. Case report and review of literature. *American Journal of Sports Medicine*, 19: 665–667. https://doi.org/10.1177/036354659101900620

Whitesides T.E., Haney T.C., Morimoto K., Harada H., et al., 1975. Tissue pressure measurements as a determinant for the need of fasciotomy. *Clinical orthopaedics and related research*, 113: 43–51.

Yassi A., 1997. Repetitive strain injuries. *Lancet*, 349 (9056): 943–947. https://doi.org/10.1016/S0140-6736(96)07221-2