Carpal tunnel syndrome

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Published in the Revista de Ortopedia y Traumatología (Iberian Edition), 12 (1) 53-64, 1968.

The Carpal Tunnel Syndrome (CTS) is a condition brought about by the compression of the median nerve at some point along the carpal tunnel. Although various studies have been published in the past few years on the CTS, its existence remains largely unknown amid the medical profession, which leads to erroneous diagnoses and stands in the way of appropriate treatment. An accurate diagnosis in the early stages of the disease is of paramount importance since it is then that treatment stands a greater chance of success.

The first report on this syndrome was made by Putman in 1880. Hunti (1909) considered that isolated atrophy of the thenar eminence without sensory disorders belonged in the group of occupational palsies. Brouwer found that this condition appeared chiefly in persons with occupations characterized by intensive use of the pollux. Dorndorf attributed the typical motor alterations to a lesion of the neurons of the anterior horn. Woltmann was the first to detect the presence of sensory alterations in cases atrophy of the thenar muscles. His cases comprised only acromegalic patients.

Referring to this condition as a «syndrome» is quite accurate, since there is a multiplicity of causes that can lead to the compression of the median nerve at this level. In general, two groups of causes can he identified:

— A compression syndrome caused by a skeletal abnormality of the carpal tunnel.

— A compression caused by alterations in the contents of the carpal canal or in the transverse ligament.

The sensitivity of the median nerve as it runs through the tunnel formed by the carpal canal and the transverse ligament can be well understood if one analyzes the *anatomical specificities* of this region. The inside of the carpal canal comprises the pisiform bone and the unciform process of the hamate. The bones of the first carpal row, which are intimately joined together, form the floor of the canal. The scaphoid tubercle and the trapezium make up the external wall of the canal. The transverse carpal ligament, or flexor retinaculum as it has been called more recently, spans the carpal canal as if it were a bridge. This 2 cm-wide fibrous band is attached to the walls of the canal, which come close to each other during ventral wrist flexion at the same time as the scaphoid tubercle emerges from the floor. The canal diameter narrows caudally, the narrowest area being located at 2.5 cm from the entrance to the canal. By means of an appropriate technique it is possible to obtain an accurate radiographic representation of the different bone components of the carpal canal (figure 1).

This natural passage towards the hand is used by flexor digitorum tendons, the flexor pollicis longus and the median nerve. The latter, which is flat in its dorso-ventral region, is in direct contact with the flexor digitorum superficialis indicis muscle.

The compression syndrome caused by alterations in the walls or the floor of the canal is seen exclusively as a result of wrist trauma, the presence of bone tumors being the exception rather than the rule. We have observed post-traumatic CTS in three types of injury:

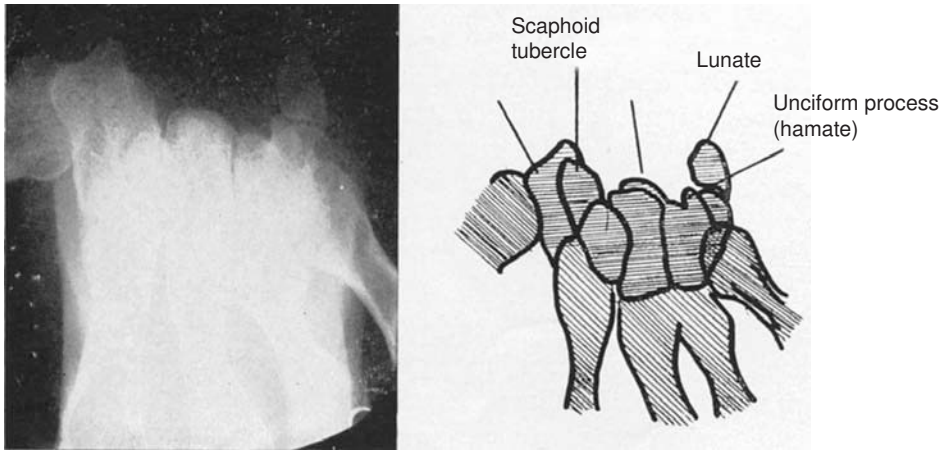

Fig. 1. *X-ray view of the carpal canal.*

Fig. 2. *Massive thickening of the transverse ligament is clearly visible. The median nerve shows evident strangulation at the level of the upper edge of the ligament.*

— Isolated lunate dislocation or perilunate carp dislocation (old cases that were not appropriately reduced).

— Malunited radial fractures that led to wrist arthritis.

— Fracture of the hook of the hamate

Nevertheless, this secondary traumatic form is relatively rare in comparison with the so-called *idiopathic* varieties, whose origins are not yet fully understood. Different etiological factors play a role in these cases:

A *Hormonal* influence is undeniable if the following factors are taken into account:

— Predominance of menopausal females.

— Discomfort appears during pregnancy and disappears alter childbirth (Wilkinson).

— Co-occurrence of acromegalia and CTS, both of which tend to improve further to irradiation of the pituitary gland (Woltmann, Mletzko, Schiller and Kolb).

— Improvement of symptoms further to estrogen treatment (Reid).

A *mechanical* factor could explain the predilection of CTS for certain occupations in which thumb opposition is frequent. This theory seems to be confirmed by the studies by Brain, who observed that during forceful wrist flexion the pressure inside the tunnel increases threefold.

However, the most frequent finding in the operated cases corresponds to the presence of *inflammatory alterations* in the tendon sheaths or in the transverse ligament, with a special predominance of rheumatoid synovitis. We have often found unspecific De Quervain-type fibrosclerotic tenosynovitis. Tuberculous tenosynovitis is a rare occurrence. The exceptional etiological factors observed include gouty tophi, ganglia, pisiform bursitis, tendon sheath amyloidosis, lunar artery thrombosis, hemangioma, etc. Lastly the anatomical anomalies reported include the presence of aberrant vessels, an atypical median nerve course and an accessory palmar tendon. In one of the cases we operated, we found a granuloma caused by a splinter of glass.

PATHOLOGICAL STUDY

Alterations identified in the transverse carpal ligament go from slight edema to massive thickening, as can be seen in figure 2, which corresponds to one of our own cases with bilateral involvement. The tendon sheaths showed slight inflammatory signs with diffuse infiltration and adhesion formation. In incipient cases there tends to be slight hyperemia of the median nerve perineurium. Histological examination of the transverse ligament and of the tendon sheaths of the case in figure 2 revealed connective tissue that was rich in fibers but lacking in cells and intense collagen degeneration with hyaline hollowing out of the fibers and a basophilic reaction. On the other hand, microscopic examination of the tissue obtained from the contralateral hand (the syndrome was bilateral) showed intense fibrinoid degeneration.

Median nerve lesions range from slight edema in cases treated early to nerve strangulation at the entrance to the tunnel and fusiform nerve thickening underneath. This is clearly visible in figure 3. In the early stages, histological analysis of the nerve shows vacuolar myelin degeneration, accompanied by local edema with cell infiltration. In the later stages, walterian degeneration is present with partial discontinuity of nerve fibrils.

PATHOLOGICAL ANALYSIS

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Median nerve lesions range from slight edema, in cases treated early, to nerve strangulation at the entrance to the tunnel, with spindle-shaped thickening of the nerve below

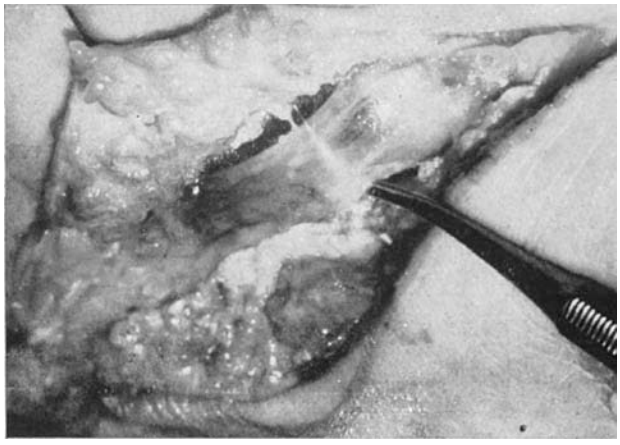

Fig. 3. *The same case as in figure 2, but in greater detail. The median nerve has shrunk to a band of a few millimeters in thickness. Below the strangulation a spindle-shaped thickening of the nerve can be observed.*

the entrance to the tunnel. This can be clearly seen in figure 3. Histological examination of the nerve reveals an early-stage myelin vacuolar degeneration, accompanied by local edema with cell infiltration. More advanced stages are characterized by wallerian degeneration with partial discontinuation of nerve fibers.

CLINICAL STATUS

CTS appears predominantly in females of ages between 40 and 55, with those performing certain types of manual work at the highest risk. In advanced cases, symptoms are so typical that a diagnosis can be made without any special test. Below we shall describe one of our cases as an example:

F. G., a 57-year-old male. Family and personal history were uneventful. In 1960, he experienced numbness in the right thumb and index. A few months later, the same symptoms appeared on the left hand. In 1961, the patient developed acute multiple joint rheumatism that involved both elbows and wrists. Treatment with butazolidin improved rheumatoid manifestations, although paresthesia still affected the thumbs and index fingers. In 1962, stabbing pain appeared in both middle fingers. In 1963, the patient noted for the first time the atrophy of the thumb muscles and a lack of sensitivity in both thumbs and index fingers. Since then, the patient has received continuous treatment in different clinics with diverse diagnoses (cervical osteochondrosis cervical, rheumatism, cervical syndrome, etc.). Symptoms have proven refractory to all sorts of treatment. The patient was admitted into our hospital in January 1965. His initial clinical examination can be summarized as follows:

Fifty-seven year old male with a satisfactory health status. Slight thickening of the ganglia in both axillae. Slight hepatomegalia.

Skeletal system: Slight limitation of rotation movements and of the inclination of the cervical spine. Increase in local temperature at both elbows and wrists. Marked atrophy of the thenar eminence on both sides (fig. 4) but particularly in the right hand (fig. 5). The thumb remains in adduction and cannot be actively opposed. Reverse Froment's maneuver was positive. Prehension of coins with the eyes closed in made with the radial side of the thumb and with the little finger. Virtually complete numbness in the flexor region of rays 1 to 3 and at the radial midpoint of the ring finger. The skin covering these rays lacks sweat secretion. Moberg's picking-up test shows a virtual disappearance of the openings of the sweat glands in the area innervated by the median nerve.

Radiological examination of the cervical spine suggests the presence of advanced osteochondrosis at C4 C5 and C6 with arthritis at all uncovertebral joints. Furthermore, cervical dysplasia was observed with functional assimilation of the atlas.

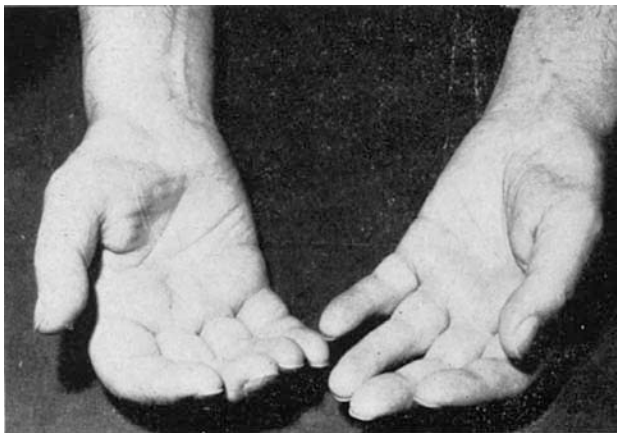

Fig. 4. *Intense atrophy of the thenar muscles on both hands. Thumbs are kept in adduction.*

Fig. 5. *Typical atrophy in a case of advanced CTS. Thumb opposition was altogether lacking.*

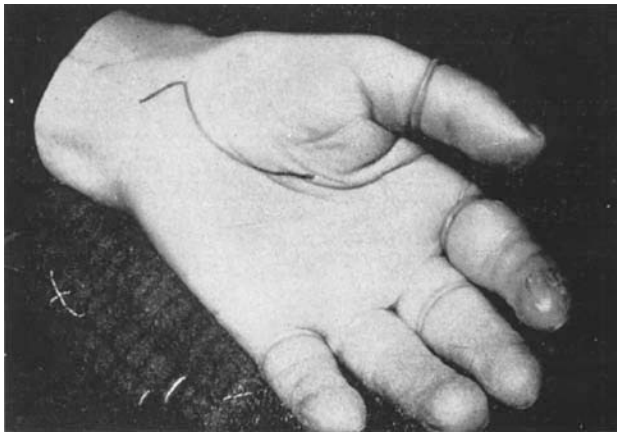

Fig. 6. *Oblique incision on the wrist that is continued along the medial border of the thenar eminence, making it possible to check the motor branch of the medial nerve.*

Laboratory tests only reveal a slight disruption of electrophoresis with a decrease in albumin and an increase in globulin levels.

All of these findings correspond to the end stage of CTS. Although diagnosis should pose no problems, we can see that in this case it was given 5 years after the onset of discomfort. Median nerve decompression led to significant pain relief and sensitivity disorders abated after a few weeks, albeit not fully so. We insist that an early diagnosis is necessary for surgery to be carried out at a stage at which lesions are not yet irreparable.

As was the case in the case reported herein, the first few symptoms of the disease are of a subjective kind. In most patients pain is the first symptom. This pain typically irradiates to the rays innervated by the median nerve, patients complaining especially of pain in the middle finger. Pain is either of a stabbing spasmodic nature or is reported as a sudden electrical shudder. Nocturnal exacerbation is common, accompanies by paresthesias (nocturnal paresthetic brachialgia). On other occasions, the first manifestation refers only to paresthesias, without any report of pain. The thumb and index finger are normally numb. The middle finger is usually affected at a later stage.

Several years tend to elapse from the appearance of the first signs of discomfort to the full-blown development of the disease. The patient feels increasing clumsiness to perform the usual hand movements, being especially struck by the weakness of the thumb and index finger. This is the stage at which thumb muscle atrophy usually sets in.

Motor symptoms rarely constitute the first manifestation of the disease. The patient consults with his doctor on having become aware of an intense atrophy of thumb muscles.

In order to establish an accurate diagnosis, the physician must draw on the data furnished to him by the clinical examination and other ancillary methods.

CLINICAL EXAMINATION

— Meticulous examination of the degree of sensitivity, which must be carried out with the techniques commonly used in the neurological setting (cotton swab, Weber's compass, hot and cold water tubes). These techniques will often reveal generalized hypoesthesia in the rays innervated by the median nerve.

— Detailed examination of thumb motility. The functions of the short abductor, the short flexor and, especially, of the opponens pollicis are significantly impaired. Prehension of small objects is carried out between the root of the thumb and the base of the index finger (reverse Froment's maneuver).

Other signs have been described, whose value however seems more doubtful:

— Tapping the median nerve along its course in the wrist elicits keen pain (Tinel's sign).

— Applying the blood pressure cuff for one minute gives rise to the appearance of paresthesias in the rays innervated by the median nerve (Gilliat and Wilson's sign).

— Flexing the wrist for 30 to 60 seconds produces tingling or numbness, which go away when the hand returns to its normal position (Phalen's maneuver).

The clinical examination will be completed by ancillary diagnostic tests. The following are the most important:

— Moberg's test. Based on the alteration of sweat secretion provoked by consecutive lesions to the vegetative fibers. Once the fingers have been wiped clean, the finger tips are pressed on a strip of white paper, which is impregnated in the following solution:

Ninhydrine 1.0
acetone 100.0

If there is sweat secretion, after one minute the openings of the sweat glands will be represented in black.

— Radiographic view of the carpal tunnel. We perform x-rays in all cases in order to rule out alterations to the bone structure. Figure 1 shows that the carpal tunnel can be fully recognized if an appropriate technique is used; such technique will be described below. The wrist to be explored is placed horizontally on the x-ray plate, placing the hand in maximum dorsal flexion. The x-ray tube is placed in such a way that the beam should form a 65° angle with the plate. Focus-to-plate distance = 190 cm. Voltage of 60 kilovolts is applied for an exposure time of 2/10 seconds.

— Electromyogram. This is the most valuable tool for diagnosing CTS. In cases of nerve compression the conduc-

tion rate of the stimulus decreases. Distal latency time for the abductor pollicis brevis, when stimulated at the wrist, ranges between 2.2 and 4.3 milliseconds. In 85% of cases of CTS, latency time is considerably increased.

TREATMENT

Conservative methods fail to produce positive results. Patients who prefer not to undergo surgery may obtain a temporary improvement by wrist immobilization or a local cortisone injection. Sometimes a change of jobs is sufficient to relieve discomfort.

Surgical treatment consists in the decompression of the median nerve at the level of the carpal tunnel. We perform the procedure under tourniquet control. So far we have only used brachial plexus anesthesia, in accordance with Kulendaff's technique. We still lack enough experience of intravenous local anesthesia.

An oblique incision is made on the anterior aspect of the wrist, which is continued towards the hand following the internal border of the thenar eminence. We firstly isolate the nerve above the tunnel, which can be done easily by taking as a reference the tendons of the palmaris longus and palmaris brevis muscles. Once the median nerve has been identified, its course is followed until it enters the tunnel. At that point, the transverse ligament must be sectioned. The motor horns associated to the muscles of the thumb must be examined in all cases. The transverse ligament must be sectioned from beginning to end. When no alterations to the tendon sheaths are found, the only requirement is to suture the skin with as little tension as possible. In some cases, Kalman sections the tendon of the palmaris brevis muscle, a maneuver we do not consider necessary. Once the skin has been sutured, we apply a compressive bandage and a plaster cast, which are retained for 10 days, deflating the tourniquet once the bandage in fully in place.

Relief of preoperative pain is normally immediate. Return of sensitivity depends on the duration of symptoms preoperatively. In cases operated early sensitivity returns a few days after surgery. Otherwise, months can elapse before normal sensitivity is achieved. Recovery of opponens pollicis function takes longer and even in cases of full recovery some marginal muscle atrophy usually remains.

In the literature reviewed, statistics are unanimous in terms of the results afforded by the procedure. Generally, the percentage of good results (disappearance of pain, return of sensitivity and recovery of opponens function) ranges from 80 to 85%. Our experience is generally in line with that of other authors. Nevertheless, our number of cases is still low and therefore not yet statistically significance.

SUMMARY

In this study we have presented a detailed study of the carpal tunnel syndrome since we condition that this is an ill-known condition. Our work is based on a review of the international literature published to date and on the analysis of our clinical material. We emphasize the importance of early diagnosis and report of modern diagnostic techniques used by the author. Lastly, the surgical technique is described.

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Comment

Forty years after Dr. Rico Agudo wrote his paper, carpal tunnel syndrome (CTS) has become a different entity, not only in terms of its prevalence among the general population but also as regards its diagnosis and treatment.

Nowadays, CTS is the most frequent condition involving the wrist and affects approximately 10% of women between 45 and 55 years of age; one-third of cases are bilateral. As regards its origin, if we exclude cases secondary to bone pathology (post-traumatic distal radius deformities) and of static space occupancy (rheumatoid arthritis or amy-