Trapezio Metacarpal Instability and Arthritis: Etiopathogenetic Interpretation and Surgical Technique

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Trapezio metacarpal joint (TMJ) arthritis depends on various etiologies including joint laxity, repetitive stresses, hypoplasia of the trapezium bone, and musculotendinous anomalies. The anatomy of the musculotendinous insertions described in textbooks is found very seldom in reality. Only in 2 cases out of 100 hand dissections did we find 1 abductor pollicis longus (APL) tendon. The number of tendons of the first wrist compartment averaged more than four, in different arrangements.

In 72% of cases we found one or two tendons going to the trapezium. This insertion makes the abducing force act on the whole column of the thumb. If the trapezium insertion is not present, a harmful shearing effect on the TM joint is exerted by the abductor pollicis longus. In our random dissections, the presence of tendons to the trapezium was not associated with arthritic changes. Conversely in 46 patients operated on for TM arthritis, the tendon to the trapezium was absent. Stabilization of the TM joint has been sought by means of various operations with complicated techniques and unpredictable results. We have set up a new technique which removes one of the APL tendons, using it to build a new interosseous pivot ligament. In this way the joint is given stability and the pinch is stronger without reduction in freedom of movement. The tendon is severed 6 cm proximal to its insertion and drawn distally. A hole is pierced through the bases of the first and second metacarpal and the tendon pulled throughout the holes and sutured to the fibrous tissues at the base of the second metacarpal. We have operated on 34 cases of TM instability or TM arthritis at stage 1 or 2. Results were good or very good in 32 of them. In cases of severe arthritis, this stabilization is used in combination with resection arthroplasty. The new interosseous ligament prevents recession of the first metacarpal and gives better stability to the thumb. We have had 13 cases of resection arthroplasty plus stabilization until now with good or very good results.

Arthritis of the trapezio metacarpal joint (TMJ) is a very frequent condition painfully impairing the function of the hand. It occurs more frequently in females after the age of 50. Etiology is various: capsular laxity, trapezium hypoplasia, particular occupations (repetitive thumb adduction), trauma, and so on.[1-6]

In reality repetitive stresses in adduction combine two forces dislocating the base of the first metacarpal (Fig. 1): the pulling of the APL tendon at the base of the metacarpal and the basculating action exerted by the adductor pollicis when working in adduction.[3,4] In contrast, by working in abduction (grasping thick objects), the base of the metacarpal is centered upon the saddle of the trapezium. This is the commonly held belief about TM arthritis.

There is one additional factor causing TM arthritis. It has been detected by our research on cadavers (100 hands) and on patients during surgery. The APL is frequently a multitendon muscular unit (or complex).[7] Several authors have recognized two or three APL tendons inside the first dorsal compartment of the wrist (besides the extensor pollicis brevis (EPB).[8]

We were able to count up to seven tendons. Some authors gave etiological importance to the tendon(s) inserting in the abductor pollicis brevis (APB) muscle or fascia. As a matter of fact,

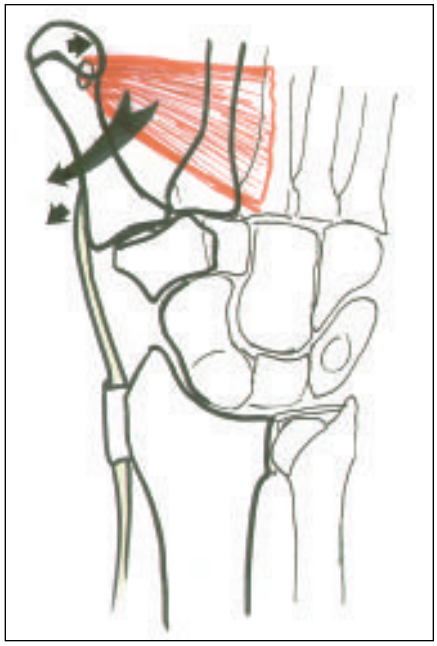

Figure 1. Two forces act on the first metacarpal with dislocating effect on its base: the APL which pulls laterally and the adductor pollicis which gives a basculating effect on the base of the metacarpal.

Table 1. Correlation of the insertion in the trapezium with TM arthritis changes (number of cases)

	No arthritis stage 1, 2	Instability stage 3, 4	Arthritis	Arthritis
Present: 72	52 (72.2%)	1 (1.39%)	17 (23.47%)	2 (2.78%)
Absent: 28	1 (3.56%)	6 (21.24 %)	6 (21.24%)	15 (40%)

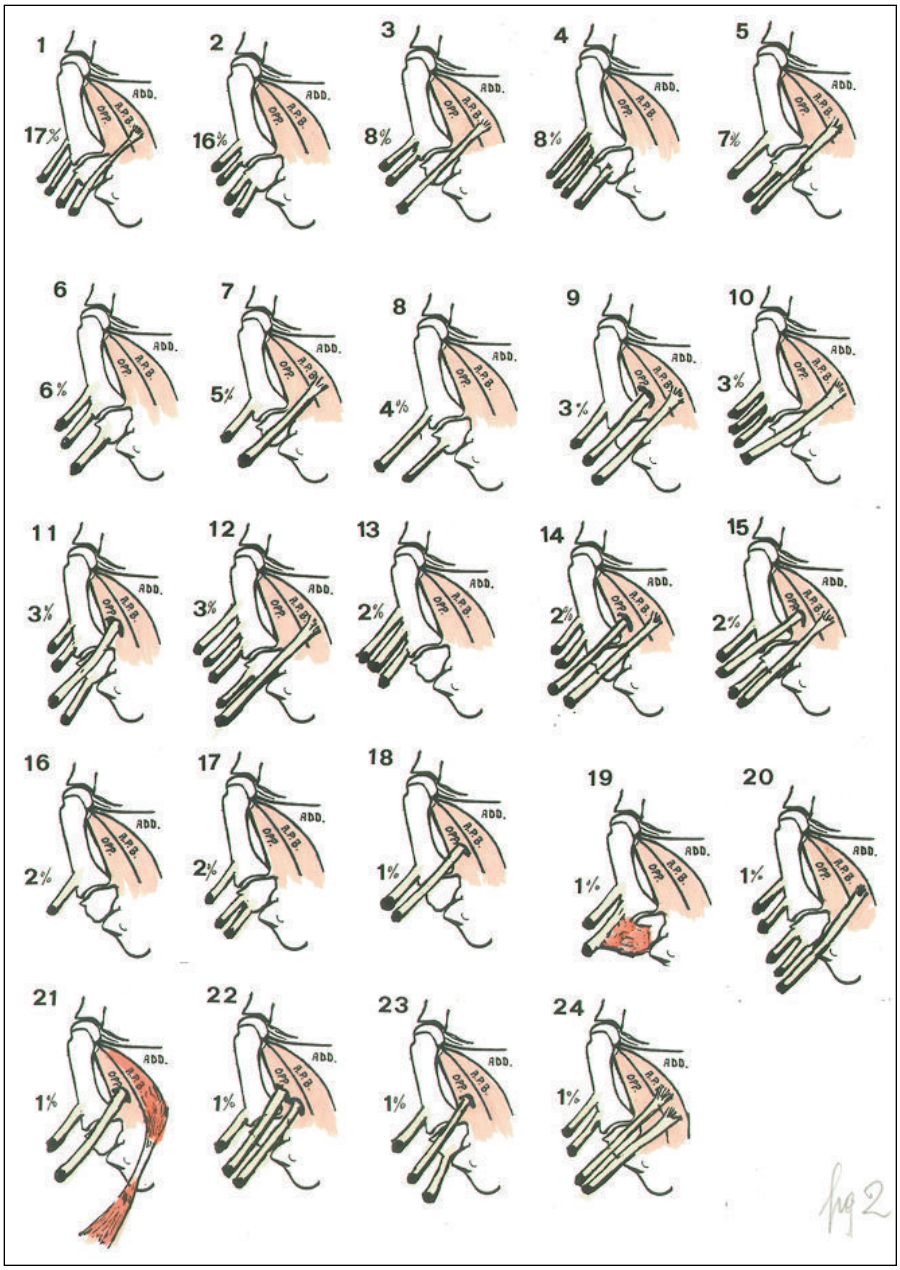

Figure 2. Twenty-four different patterns of APL distal insertion have been found by dissecting 100 hands. Their types and percentages are presented here.

the insertion of a tendon in soft tissue does not substantially affect the biomechanics of the joint. On the contrary, there is an anatomical condition (disregarded until now) impairing the TMJ function. This is the shearing effect exerted on the TMJ by the APL when there is no insertion in the trapezium bone. By cadaveric dissection, we were able to find that (1) practically in all the cases (98%), there were several APL tendons (up to seven); (2) 72% of the specimens had at least one insertion in the trapezium bone (19% had two tendons going to the trapezium). Therefore, this insertion has to be considered normal and its absence abnormal.

In 100 dissections, we found 24 different patterns of distal insertions of the APL (Table 1). If the trapezium insertion is present, the entire column of the thumb moves at the same time (Fig. 3). If this insertion is lacking, the APL pulls only at the base of the first metacarpal with a harmful shearing effect on the TMJ. By correlating the presence of this insertion with arthritic changes in cadavers, we were able to see that in the presence of the tendon going to the trapezium, there were only 28% slight arthritic changes while in the absence of it, 95% of joints showed changes (40% at stage 3 and 14% at stage 4). The fact is that when operating on TMJ arthritis, the insertion in the trapezium is rarely seen. This confirms the data derived from cadaver dissections because the absence of this insertion is strongly linked to and appears to be the main cause of TM arthritis.

The problem caused by TM arthritis is extremely complex. We have studied the different pathophysiologic possibilities related to the onset of symptoms. The goal of the surgical approach must be adapted to the different situations. It must prevent arthritis in the case of instability, stop its progression in stages 1 and 2, and remove the arthritic trapezium. In stages 3 and 4, resection arthroplasty must be done with stabilization in order to prevent the recession of the first metacarpal.

Various types of stabilization of the TMJ have been suggested and attempted up until now. Few are effective while many are difficult to perform and their results unpredictable.[9-12] After various attempts on cadavers, we set up a surgical technique aiming to stabilize trapezio metacarpal instability and subluxation. One of the tendons going to the first metacarpal is cut 7 cm proximal and pulled out of the first dorsal compartment of the radius (Fig. 4a). If there is only one tendon inserted on the base of the metacarpal, it will be longitudinally severed and half of it will be taken. The tendon is used for the construction of the new interosseous pivot ligament between the base of the first and second metacarpal. Thus one of the dislocating forces on the base of the first metacarpal will also be attenuated.

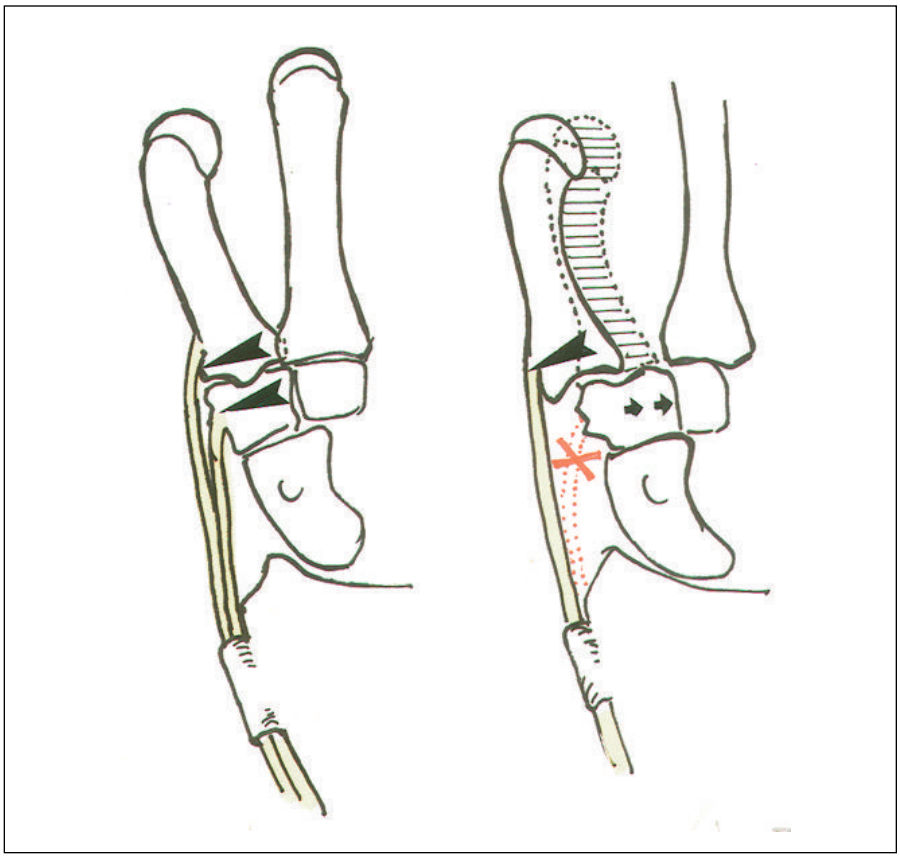

Figure 3. If the insertion on the trapezium is present, both the metacarpal and trapezium are pulled together. If the insertion is lacking, only the base of the metacarpal is pulled with a harmful shearing effect on the TM joints.

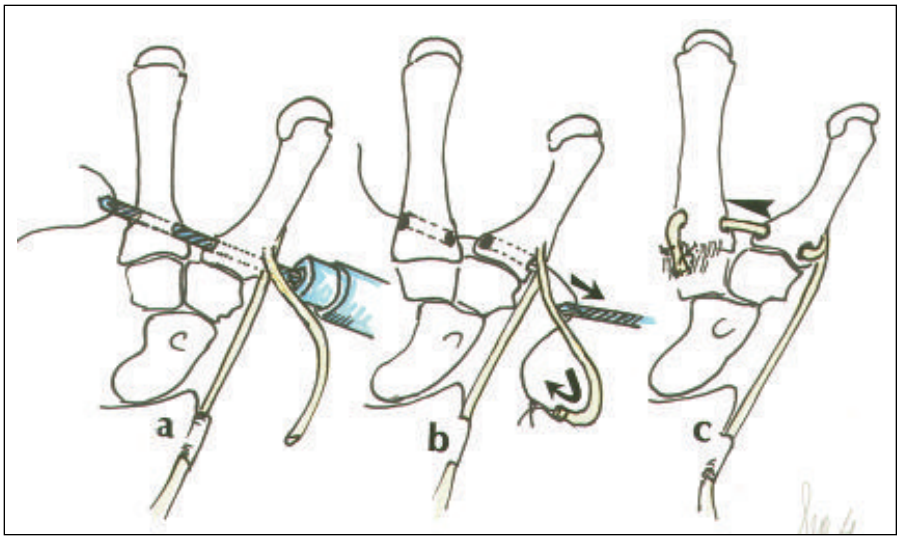

Figure 4. Various types of TMJ stabilization. (a) One of the tendons going to the first metacarpal is cut 7 cm proximal and pulled out of the first dorsal compartment of the radius. (b) A 0-nylon thread is passed through the eye of the drill and pulled backwards. (c) The tendon is sutured to the thick fibrous tissues at the base of the second metacarpal (periosteum and ligaments).

At the beginning, all the tendons were brought to the metacarpal, aiming to annul their dislocating effect, but in one case a very severe case of adduction of the first metacarpal resulted. Therefore since then, at least one abductor pollicis longus tendon has been left. The selected tendon is pulled distally, and the base of the metacarpal underlying it is released around 5 to 7 mm.

By means of an eyed drill, a tunnel 2.5 mm in diameter is pierced throughout the base of the first metacarpal, parallel to its articular surface, 2 to 3 mm from it. It is directed towards the base of the second metacarpal, which is also perforated by keeping the first metacarpal in abduction-opposition. The drill will leave the second metacarpal on the back of the hand. A small incision is made to position the point of the drill. A 0-nylon thread is passed through the eye of the drill and pulled backwards (Fig. 4b). The stump of the tendon is taken with a slip knot of 000-nylon thread which is pulled dorsally by means of the first 0-nylon thread, passing throughout the bases of the first and second metacarpals. The tendon is sutured to the thick fibrous tissues at the base of the second metacarpal (periosteum and ligaments) (Fig. 4c). In this way a strong interosseous pivot neoligament is obtained which keeps together the bases of the first and second metacarpals allowing unrestricted movements (Fig. 5). This operation has proved to be effective in stabilizing the carpal-metacarpal laxities and instabilities and in preventing the progression of stage 1 and 2 arthritis.

Figure 5. Result at four years of a TM joint stabilization on a hypoplastic trapezium with the technique which is presented in this article.

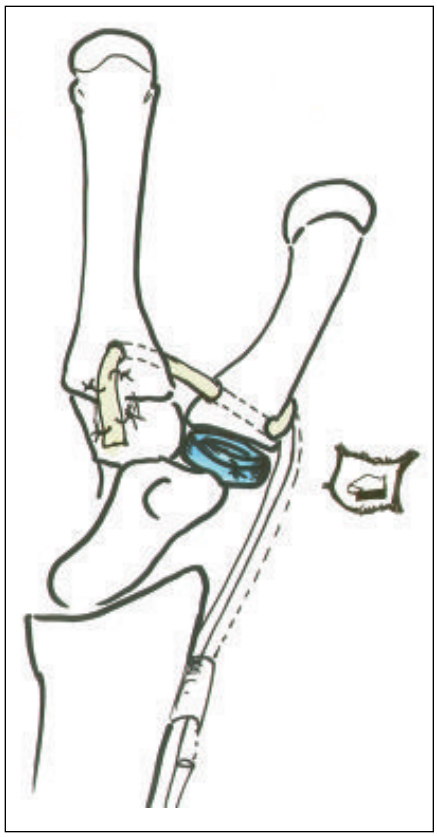

Figure 6. Scheme of the interpositional-resection arthroplasty (anchovy procedure plus stabilization).

Figure 7. AP view of a interpositional-resection arthoplasty plus stabilization at long-term follow-up.

In severe arthritis cases, the trapezium is removed and fibrous tissue is then interposed between the base of the metacarpal and the distal pole of the scaphoid (anchovy procedure). This is a common procedure in use for many years. The common result is the recession of the metacarpal with reabsorption of the tendon-spacer, shortening of the thumb, impingement, and the recurrence of pain.

The use of the same tendon stabilization described above prevents such recession (Fig. 6-8). In addition, interpositional arthroplasty gives generally a greater range of movement, although at the expense of a loss of strength. The addition of the stabilizing procedure improves the strength.

In summary, the construction of a new intercarpal pivot ligament by stabilization of the base of the first metacarpal restores the strength while relieving the pain.

Besides 44 previous operations including prosthesis and arthrodesis, our new series consists of 33 cases of stabilization and 13 cases of biological interpositional arthroplasty associated with stabilization. The TMJ stabilization group consisted of 5 males and 28 females. The average age of the patients was 51 years (ranging from 18 to 67 years). The average follow-up is 8 years (ranging from 6 months to 13 years).

ROM was improved in 26 out of 33 cases, unchanged in 4 out of 33, and reduced in 3 out of 33. The latter were young ladies with severe instability so that the reduction of ROM has to be considered a good improvement. Regarding strength, improvement was seen in 32 of 33 cases, and 32 patients were satisfied. The unsatisfied patient had suffered a TMJ dislocation due to the lengthening of the first metacarpal performed after amputation of the thumb phalanges by means of an external fixator and, therefore, this technique is a contraindication. Regarding pain, 28 of 33 were completely pain-free while 5 had light pain under stress.

The group of biological interpositional-resection arthroplasty plus stabilization consisted in 13 cases with an average follow-up of 5 years. ROM was improved in 12 of 13 cases. Twelve patients were pain-free and declared subjective satisfaction. One case had persistent pain due to impingement of the base of the first metacarpal against that of the second and underwent arthrodesis with bone graft.

Figure 8. Another long-term follow-up of a resection arthroplasty plus stabilization (lateral view).

In conclusion, the use of one of the tendons of the APL complex is very effective in stabilizing the TMJ, in preventing or arresting the arthritic changes, and improving the results of resection arthroplasty.

In severe TM arthritis, traditional surgery, with the exclusion of joint replacement (which has many potential complications), may supply either pain-free solidity by means of fusion (with the drawback of stiffness) or wide pain-free movement (with the drawback of instability). Today, by adding stabilization to interpositional-resection arthroplasty, mobility with stability is obtained. STI

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