REVIEW ARTICLE

Trapeziometacarpal arthroscopy: classification and therapeutic algorithm

A. Badía[a] and R. Plaza[b]
[a]*Miami Hand Center. Co-founder of the DaVinci Learning Center and Head of the Department of Hand Surgery at the Baptist Hospital of Miami. Florida. United States*
[b]*Department of Orthopedic and Trauma Surgery. Barcelona Clinical Hospital. Barcelona. Spain.*

Trapeziometacarpal arthroscopy: classification and therapeutic algorithm

Trapeziometacarpal arthritis is a common pathology and there are a large number of surgical techniques to treat it. In the last few years, resection arthroplasty and arthrodesis have been used, but they are too aggressive and do not seem a good option for young patients, who make great demands upon the joint. On the other hand, for a correct surgical indication, in addition to the type of patient the stage the disease is at should be considered.

Arthroscopic surgery of the area makes it possible to assess the condition as well as to perform a debridement, synovectomy and other surgical maneuvers, although it is most useful for the least advanced cases with a well-preserved trapezium. For that reason, it is best to perform a thorough classification of the disease that can guide diagnosis and treatment; therefore a new staging is proposed.

Arthroscopic stage I: it is characterized by diffuse synovitis with little or no loss of articular cartilage. Ligament laxity is common. These patients are candidates for either mechanical or RF synovectomy and, if ligament laxity is present, then a retensioning capsulorrhaphy can be performed.

Arthroscopic stage II: there is limited erosion of the joint surface of the central and dorsal areas of the trapezium. This is an irreversible situation that requires some type of technique that can modify the joint by altering the force vectors acting upon it. After synovectomy, a debridement is performed, followed by the occasional excision of intraarticular bodies and, in many cases, a thermal capsulorrhaphy often associated to a chondroplasty of the margins. Subsequently, a dorsoradial closing-wedge metacarpal osteotomy is performed to keep the thumb in a more extended and abducted position, thus minimizing the metacarpal's tend to subluxate.

Arthroscopic stage III: characterized by a more diffuse loss of the trapezial joint surface. The base of the metacarpal can present with different types of chondral injuries. Their treatment tends to be complex and debridement and corrective osteotomy are often insufficient. In these cases a hemitrapezectomy is necessary; the remaining cartilage must be removed, reaming through the subchondral bone until a bleeding plane is reached. In this way, the joint space can be increased and an organized blood thrombus be created, where an autologous or synthetic tendinous interposition graft may be attached. Stage III can also be treated by means of a classical open-wedge resection arthroplasty, an arthrodesis or prosthetic implantation, depending on the surgeon's preferences.

Key words: *arthroscopy, trapeziometacarpal, rizarthrosis, osteoarthritis, thumb.*

La artrosis trapeciometacarpiana es una patología frecuente, de la que existen gran número de técnicas quirúrgicas para su tratamiento. En los casos avanzados se han utilizado las artroplastias de resección y la artrodesis, pero son agresivas y no parecen una buena opción para los pacientes jóvenes, que tienen una gran demanda de la articulación. Por otro lado, para una correcta indicación quirúrgica además del tipo de paciente debe considerarse el estadio de la enfermedad.

Con la cirugía artroscópica de la zona es posible su evaluación, desbridamiento, sinovectomía y otros gestos quirúrgicos, teniendo quizás su mayor utilidad en los casos poco avanzados y con un trapecio conservado. Por ello, es deseable disponer de una adecuada clasificación artroscópica de la enfermedad que oriente en el diagnóstico y tratamiento, por lo que se propone un nuevo estadiaje.

Corresponding author:
A. Badia.
Miami Hand Center.
8905 SW 87th Avenue
Suite 100
Miami. Florida 33176. United States.
E-mail: alejandro@drbadia.com

Received: June 2007.
Accepted: June 2007.

Estadio artroscópico I: se caracteriza por sinovitis difusa, pero con mínima o nula pérdida de cartílago articular. Es frecuente la laxitud ligamentaria. Estos pacientes son candidatos a una sinovectomía, tanto mecánica como por radiofrecuencia, y si existe alguna laxitud ligamentaria se puede realizar una capsulorrafia de retensado.

Estadio artroscópico II: presencia de un desgaste limitado en la superficie articular de la zona central a la dorsal del trapecio. Representa una situación irreversible que precisará de algún tipo de técnica que modifique la articulación para alterar los vectores de fuerza que actúan sobre la misma. Tras la sinovectomía, desbridamiento, ocasional exéresis de cuerpos intraarticulares y en muchos casos capsulorrafia térmica asociada frecuentemente a una condroplastia de los márgenes; después se practicará la osteotomía de cierre dorsorradial del metacarpiano para mantener el pulgar en una posición más extendida y abducida, minimizando así la tendencia que tiene el metacarpiano a subluxarse.

Estadio artroscópico III: se caracteriza por una pérdida más difusa de la superficie articular del trapecio. La base del metacarpiano puede presentar lesiones cartilaginosas de distinto grado. Su tratamiento va a ser más complejo, resultando insuficientes el desbridamiento y las osteotomías de corrección. Es necesario realizar una hemitrapecectomía fresando los restos de cartílago y profundizando a través del hueso subcondral hasta llegar a un plano sangrante, para aumentar el espacio articular y producir un trombo sanguíneo organizado en el que pueda adherirse un injerto de interposición tendinoso autólogo o sintético. El estadio III también podría tratarse mediante una clásica artroplastia de resección abierta, artrodesis o protetización, dependiendo de las preferencias del cirujano.

Palabras clave: *artroscopia, trapeciometacarpiana, rizartrosis, osteoartritis, pulgar.*

Trapeziometacarpal joint arthritis is a frequent pathology that constitutes a major challenge for surgeons due to the fact that a great number of surgical techniques have been described. The existence of various options shows that none is completely optimal. However, it may also imply that surgeons will find most of these techniques satisfactory, though they may not be the most adequate for a particular stage of the condition. Thumb-base arthritis, for instance, has numerous clinical manifestations and each stage of the condition and each patient requires a specific technique.

Following the relatively less prevalent distal interpahalangeal joint (DIJ), the carpo-metacarpal joint (CMCJ) is the most frequent location of hand arthritis, which causes the greatest impediment to full hand function. Anti-inflammatory drugs, splints and cortisone injections have a merely palliative effect, none of them acting upon the biomechanics of the joint or on the joint surface proper. Furthermore, intraarticular infiltrations may accelerate cartilage loss and aggravate capsular weakening. Nevertheless, rizarthrosis has traditionally been treated surgically only when these conservative measures have failed. The main surgical option was and still is some kind of open resection arthroplasty, but this is an aggressive surgical technique, requiring complete resection of a metacarpal bone to achieve pain alleviation. It is recommended for advanced cases with a flattened trapezium bone or in the presence of great deformity with marginal osteophytes. For earlier stages a more conservative treatment that allows for more aggressive future interventions if necessary is recommended. Other common, probably less aggressive options are arthrodesis, which results in great pain relief but also causes evident loss of functioning, and total arthroplasty. In the case of arthroplasty, there is the added risk of implant failure, both in the case of silicone implants and implants with plastic or metal components. These two techniques are not a recommendable option in the case of young patients, since these generally make an active use of the joint.

The aim of this article is to describe an arthroscopic classification of CMC thumb arthritis and to present a therapeutic algorithm based on this classification. It is still optional for the surgeon whether he uses arthroscopy for final treatment, but there is no doubt concerning the fact that with arthroscopy the actual degree of the joint injury can be assessed. Before we elaborate on the arthroscopic stages, however, we must have a grasp of ligament anatomy regarding both its functional and biomechanical significance.

PREVIOUS HISTORY

The introduction of arthroscopic technology for small joints has allowed us to apply the concept of minimally invasive surgery in joints such as the wrist, the ankle and, at present, even the smaller joints of the hand. In 1979 Yung-Cheng Chen[1] showed that it was possible to perform arthroscopy of the wrist and small joints using a Watanabe N° 24 arthroscope. However, he described its use only in the wrist, the metacarpophalangeal and interphalangeal joints, with no mention of the trapeziometacarpal joint, for which it is probably the main indication.

The first article on thumb-base arthroscopy was published by Menon[2] in 1996. He describes partial arthroscopic resection of the trapezium, as well as interpositional arthroplasty with tendon self-graft, Gore-Tex or fascia lata. His patients presented with an advanced phase of arthritis, not reaching stage IV, which corresponded to those with a metacarpal base subluxation greater than one third of its diameter and adduction contracture. He did not refer to the

earlier stages of the condition; his aim was to show that arthroscopy was more useful in less advanced stages. The success of Dr. Menon's novel technique consisted in showing that interpositional arthroplasty can be performed with the help of an arthroscope without having to perform open arthrotomy prior to hemitrapezectomy, thus avoiding the resulting instability. Seventy-five percent of the 25 patients in Menon's series presented with total pain relief. The results were comparable to those obtained with the traditional open technique, but there were several advantages due to the fact that it was a minimally invasive procedure with a lower incidence of injuries in the sensitive branch of the radial nerve and less postsurgical pain. Another less obvious advantage is the fact that thumb-base arthroscopy enables a diagnosis of any change in the joint surface that is more quickly obtained than the one reached with ordinary radiologic studies. This allows us to treat thumb arthritis in markedly earlier stages and to consider not only radiologic staging as a surgical criterion but patient pain as well. Arthroscopy is, then, a procedure that enables the treatment of younger and more active patients who are in the earlier stages of the condition.

One year later, in 1997, Berger[3] published his experience with CMC thumb arthroscopy, showing its advantages with regard to open arthrotomy, these being a respect for the ligament structures of the joint and the possibility of reaching its deepest area. At that time, indications for thumb-base arthroscopy were still unclear, but Berger showed that it was an excellent technique for observing the anatomy of the joint, and subsequently using this knowledge for various pathologies, such as some acute Benett fractures. Not long after this and also in 1997, Osterman and Culp[4] presented their work on the use of thumb-base arthroscopy on two groups of patients, one with degenerative pathologies and the other with acute pathologies. They were the first to state that arthroscopy could be useful for a correct estimate of the degree of affectation of the trapezium and that it was especially appropriate for younger patients.

It is therefore evident that CMC thumb arthroscopy enables our reckoning of the stage of cartilage injury and thus our choice of surgical option. We believe that arthroscopy is useful not only in the earlier stages of the condition, but also in the more advanced stages, as Menon aptly described.

FUNCTIONAL ANATOMY

CMC thumb arthroscopy will be of little avail if the surgeon does not understand the anatomy of the joint and its ligaments. These have been described in detail thanks to anatomical dissection and it is to be expected that in the future we will be able to establish further relationships between them with the help of arthroscopic findings. The first description of the trapeziometacarpal ligaments dates from 1742, when Weitbrecht described them rudimentarily in his book *Syndesmology*[5], which was re-edited in 1969. Since then, many authors have provided details of the anatomy of the joint and its ligaments, Bettinger et al[6] from the *Mayo Clinic* being the ones to contribute the most specific work in 1999. They described 16 ligaments including the ones that connect the metacarpal with the trapezium and two that connect the trapezium with the second metacarpal. They reached the conclusion that this ligament structure functions as a composite of tension cords that prevents the instability that the curvature forces could exert on the trapezium when opposing the thumb tip to the index finger[6]. This concept was extraordinarily significant due to the fact that great forces are applied on the trapezium and this bone has no base support, since the scaphoid is a hand bone with a high degree of mobility. It is possible that the weakening or pathological functioning of these ligaments will contribute towards building a context that is favorable to the appearance of thumb-base arthritis. Basing themselves on a more effective understanding of these ligaments, Van Breck et al[7] suggested that the dorso-radial collateral ligament is the most relevant one in the prevention of CMC subluxation. They based their conclusions on a cadaveric study in which the serial section of 4 ligaments determined that the radial collateral ligament (RCL) was the one with the major relevance in preventing dorso-radial subluxation[7]. Zancolli and Cozzi[8], in their renowned *Surgical Anatomy of the Hand Atlas*, confirmed this concept, but they also added the controversial issue to the effect that anomalous extensions of abductor *pollicis longus* (APL) may produce an excessive compression force in the dorso-radial area of the trapeziometacarpal joint (TMC) that will bring about arthritis. They also suggested that joint ligament laxity may be due to inherent patient laxity or hormonal predisposition, a fact that could explain the greater incidence of this condition in females. These theories have contributed to the understanding of the causes of thumb-base arthritis, and I believe that future arthroscopic findings will probably prove them to be right. Xu et al[9] indicated that TMC is of a smaller size in females, and that its hyaline cartilage could be of a reduced thickness, thus suggesting that this could explain the greater incidence of TMC arthritis in women. As a result of my experience, I believe that arthroscopy should be used for the most part on young women presenting with the condition in its early stages and for whom there are few therapeutic options at present.

In 1979 Pellegrini[10] stressed the biomechanical role of the beak ligament (oblique volar ligament) in preventing the dorsal movement of the metacarpal during the various daily activities. This ligament and the RCL are easily visualized by arthroscopy and it is at present possible to act or

perform on them. In his hypothesis Pellegrini stated that certain degenerative changes occur as a result of the wear of the beak ligament at its attachment site at the level of the metacarpal, and that this area is also especially sensitive to estrogen components[10]. This would seem to support the genetic predisposition hypothesis. I have also observed arthroscopically a special loss of cartilage at the insertion site of the beak ligament at the level of the metacarpal base in early stages, when the rest of the cartilage appears to be normal. Many of these anatomical, clinical, and biomechanical concepts have been developed in depth by Bettinger and Berger in their work on TMC ligament functional anatomy[11]. They confirmed that arthroscopic anatomy is less complex because the structures that can be observed from the inside are limited. They were the first to point out what structures could be observed from each of the two usual entry sites. Although Bettinger and Berger analyzed the best ways to visualize structures, the reader must bear in mind that because we are dealing with a small joint we can visualize most of the joint surface by means of a simple change of direction and of the angle in which the arthroscope is positioned. Other authors have recently described additional entry sites with the aim of contributing towards a more detailed definition of the topography of the joint. Orellana and Chow[12] described a radial entry site which they considered to be safer due to its proximity to the radial artery and the superficial branch of the radial nerve. Walsh et al[13] described another entry site, the thenar eminence, which is more volar and goes through the thenar muscle to improve triangulation and visualization of the joint from a presumably safer place. Another advantage of this entry site is that no damage is caused to the anterior oblique ligament, which both Walsh and other authors such as Bettinger and Berger deem to be the main retaining structure against dorsal subluxation. This contradicts biomechanical studies carried out by Van Brenk[7]. The emergence of these new entry sites proves that CMC arthroscopic surgery is a technique undergoing evolution, and we may ascertain that in time and with new arthroscopic studies of these structures we will be able to find out the cause of dorsal subluxation and therefore of thumb-base arthritis as well.

Culp and Rekant[14] were the first clinical doctors to suggest that arthroscopic assessment, debridement and synovectomy "offered a thrilling alternative for patients with arthritis in degrees I and II on the Eaton and Litter score". They described the technique of "painting" the TMC joint capsule with radiofrequency so as to stabilize the volar ligaments and correct dorsal subluxation. They added that if the greatest part of the surface of the trapezium is altered and we therefore have a case of more advanced arthritis, the resection of at least the distal half should be carried out by means of arthroscopic burring. They performed an hemitrapezectomy or a complete trapezectomy with thermal capsulorrhaphy on 22 patients, obtaining satisfactory results in 90% of the cases in the short and middle terms. Furthermore, they proved that arthroscopy allows the subsequent performance of a more aggressive open trapezectomy if results are not satisfactory. They also concluded that debridement and thermal capsular shrinkage constitute a potentially effective technique for treatment in the early stages of arthritis[14]. These works on arthroscopic findings and results show that it is necessary to develop a more comprehensive system of stage assessment that will guide us in the treatment. Up to the present moment, all clinical results have focused on the advanced stages of arthritis and on the clinical results following arthroscopically-assisted hemitrapezectomy. It is perhaps in patients with a conserved trapezium that arthroscopy can be of greater use. We therefore put forward a new classification, Badía's arthroscopic classification (Table 1), which is described in the following pages.

Table 1. Badía's arthroscopic classification for trapeziometacarpal arthritis

Stage	Arthroscopic changes
I	Intact joint cartilage. Dorso-radial ligament injury and diffuse synovial hypertrophy. Occasional weakening of AOL.
II	Marked wear of joint cartilage in the ulnar third of the metacarpal base and in the central area of the trapezium surface. Rupture of dorso-radial ligament and greater synovial hypertrophy. Continuous weakening of AOL.
III	Total cartilage loss in both facet joints, with or without a peripheral rim. Small synovial hypertrophy. Laxity and fraying of volar ligaments

AOL: anterior oblique ligament

THUMB-BASE ARTHROSCOPY

Indications

During the last ten years the majority of the patients with thumb-base arthritis that did not improve with conservative treatment were treated using arthroscopy with the purpose of carrying out more thorough studies and a more effective surgical treatment. A radiologic staging of the condition was carried out following the criteria of Eaton[15] (Table 2). The most conspicuous exception was that of patients with arthritis degree IV. They were treated with trapezectomy and suspensionplasty using a portion of the APL. Those patients in stage IV that presented with slight changes in the scaphotrapeziotrapezoid (STT) joints were treated arthroscopically. Another group of exception was formed by elderly patients, who have a low

Table 2. Radiological classification by Eaton and Litter for trapeziometacarpal arthritis[21]

Stage	X-ray changes
I	Increased joint space, less than a third subluxation and normal joint periphery
II	Generally appearing with one third in subluxation, ostephytes (under 2mm) are present along joint margins, early wear of dorso-radial trapezium facet.
III	More than one third in subluxation, osteophytes (over 2mm) along dorsal and volar margins and mild decrease of joint space
IV	Marked decrease of joint space or destruction of facet joints, subchondral sclerosis and cysts.

functional demand. They obtained satisfactory results with a total trapeziometacarpal cemented arthroplasty, since it requires practically no immobilization and rehabilitation is brief. Many of these patients presented with adduction contracture, and open arthroplasty freed the adductor, associating a volar capsulodesis of the metacarpophalangeal (MCP) joint in the cases with a significant swan neck deformity. The final exception was constituted by a group of young male workers who were treated with arthrodesis, an indication that has been endorsed by the literature[16].

Surgical technique

The arthroscopic procedure is carried out with regional anesthesia and ischemia cuff. Only one traction jig is used on the thumb with a longitudinal traction of 2 to 4 kg. A shoulder fastening is placed on, which is superior to the traction tower because it facilitates the use of the fluoroscope. Once the patient has been positioned, the TMC is palpated and an incision for the radial entry site is performed (1-R) laterally to APL. This site is used to assess the dorso-radial ligament (DRL), the posterior oblique ligament (POL) and the ulnar collateral ligament (UCL). The ulnar entry site (1-U) is performed ulnarily to the extensor *pollicis longus* tendon (EPL) and it will enable us to evaluate the anterior oblique ligament (AOL) and the UCL more satisfactorily. The joint is distended with a 2 to 5 ml serum injection and a short 1.9 mm cannula is introduced, with the arthroscope inclined at 30°, to visualize the joint surfaces of the TMC, the capsule and ligaments. The treatment will be chosen on the basis of the arthroscopic findings. In all the cases a mechanized shaver with aspiration is used, mainly for initial debridement and to improve the visual field. In numerous cases ablation through radiofrequency is added so as to achieve a larger synovectomy. This technology and its clinical applications is discussed in the following pages. Radiofrequency is also used to carry out chondroplasties in cases of highly focal injuries in the cartilage. Ligament laxity and capsular weakness are treated with thermal capsulorrhaphy which can be carried out by using a radiofrequency probe. Great care must be taken to avoid thermal necrosis by using "striping" or linear tracing so as to tighten the capsules of lax joints.

Effects of radiofrequency on collagen

During the last decade orthopedic surgeons benefitted from using radiofrequency in various procedures, but it has been only recently that we have realized that this technology can have negative effects. Nevertheless, as with the use of any new technique, its rational employment may enable us to stabilize the joint capsule in many situations. Up to the present day it has been used to treat shoulder instability, especially in those cases of global instability and which up to the present were not considered apt for surgery. It has also been widely used in knee pathologies, but there is practically no mention of its use in hand joints, a fact which is undoubtedly related to the scanty literature on TMC and MCP joint arthroscopy.

Radiofrequency has had numerous medical applications from the time when, at the beginning of the 19th century, it started being used to heal injuries in the brain tissue, within the field of Cardiology, Oncology and Colorectal Surgery. López et al[17] were the first to show the effect of radiofrequency on the collagen ultrastructure of the joint capsule. They realized that laser had been used in similar applications in orthopedic surgery, but radiofrequency offered various advantages. It was not only less costly and safer but the instruments used were smaller and therefore easier to manage. Initial studies in lamb joints showed that the thermal effect caused the fusion of the collagen fibers without there being tissue ablation. There was also evidence of a linear relationship between the fusion of collagen fibers and the temperature applied by radiofrequency. In consequence this technology must be used with great caution and avoiding aggressiveness. It was posited that the coagulated tissue induced a mild inflammatory reaction which led to the degradation and substitution of the damaged capsule for a denser tissue. Later, Hecht et al[18] also focused their studies on monopolar radiofrequency and its effect on the joint capsule. They concluded that it caused greater capsular damage on and below the treated surface, in relation to the power used, that heat production also increased linearly according to time of use and that it could prevent permanent damage of the synovial sheath with the use of arthroscopic washout, as had been proved with the lambs. All these studies have helped to understand that radiofrequency should be used with good irrigation and with short applications, using the lowest potency needed to achieve the desired effect. We will refer to monopolar radiofrequen-

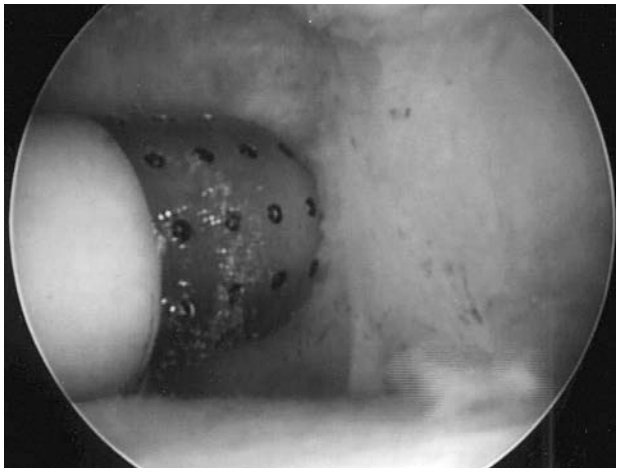

Figure 1. *Arthroscopic findings in stage one consist of the presence of synovitis around the ligament and a conserved joint surface. Thermal shrinkage of volar ligaments (through radiofrequency) can also be seen.*

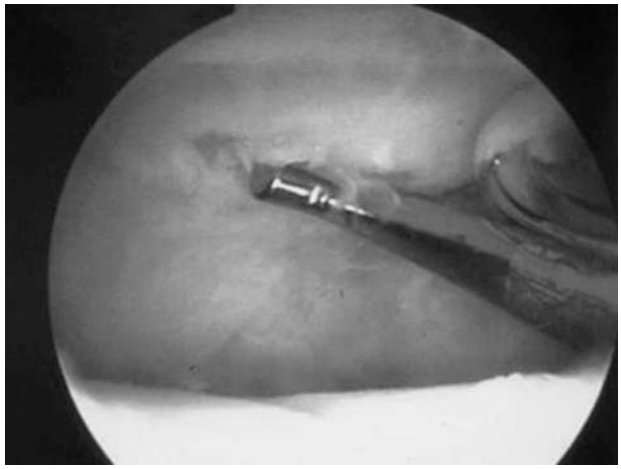

Figure 2. *In arthroscopic stage II we can observe cartilage loss limited to central joint surface of metacarpal at and in the zone of insertion of the volar oblique ligament. We also observe loss of trapezium joint surface.*

cy, since it causes less heat than the bipolar one, and is thus significant for the treatment of hand joints due to the proximity of multiple neurovascular structures.

Arthroscopic staging

Badía's arthroscopic classification (Table 2) considers three stages in trapeziometacarpal arthritis. In stage I there is diffuse synovitis, but with a minimum or nil loss of joint cartilage (fig.1). Some types of ligament laxity can be found relatively frequently, especially in the volar capsular area. It is difficult to meet patients in this stage, since they generally seek medical advice after a long period of evolution of the condition or are referred after conservative treatment has proved ineffectual. These patients are likely candidates for synovectomy, both mechanical and by radiofrequency and, in the case of there being ligament laxity, a retightening capsulorrhaphy could be performed. The thumb is subsequently protected with a splint for 1 to 4 weeks, depending on the degree of capsular laxity.

Stage II patients present with limited wear of the joint surface in the zone central to the trapezium dorsal (fig.2). In our opinion, the condition in this stage is irreversible, and will require the application of a technique that will modify the joint so as to alter the forces acting on it. Following synovectomy, debridement and, occasionally, resection of intra-articular bodies, the grade of instability and capsular weakening should be assessed. In most cases we perform thermal capsulorrhaphy, frequently associated with marginal chondroplasty. After this move, the arthroscope is removed and the ulnar site is widened distally so as to expose the base of the first metacarpal and thus be able to carry out a closed dorso-radial osteotomy, similar to the one described by Wilson[19], as shown in Figure 3.

In this way we manage to keep the thumb in a more extended and abducted position, minimizing the tendency to subluxation of the metacarpal and changing the injured places of joint contact. The osteotomy is fixated with only one Kirschner wire that goes through the CMC (figs.3 to 5). This enables the osteotomy to consolidate in a correct position, and most of the times we can already observe the correction of the subluxation. A thumb splint is placed for protection and the Kirschner wire is removed 5 weeks after surgery (fig.6) It is only with arthroscopy that the optimal position for this osteotomy can be determined. This has rendered satisfactory results in the past and also in more recent publications, such as that by Tomaino[20]. Long-term follow-up has enabled us to observe that the metacarpal continues to be "centralized", though it is not clear whether capsular retightening plays an important

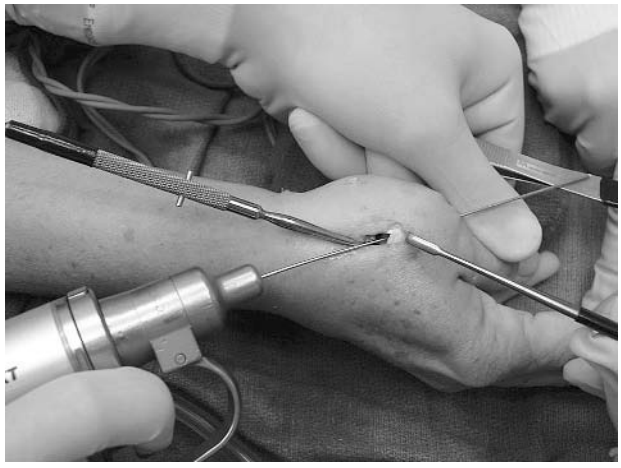

Figure 3. *Clinical image showing osteotomy technique on metacarpal, with stabilization by means of a Kirschner wire.*

Figure 4. *Pre-op X-ray of middle-aged female, showing subluxation of the metacarpal without osteophytes. Arthroscopy showed injury in trapezium surface compatible with Badía's arthroscopic stage II. Osteotomy of the metacarpal base was programmed.*

Figure 5. *Post-op X-ray showing metacarpal osteotomy and stabilization with Kirschne rwire.*

Figure 6. *Post-op X-ray one year after metacarpal osteotomy and removal of temporal fixation wire, showing how joint correction is maintained, a factor which will probably modify the evolution of the condition.*

role, since osteotomy produces biomechanical improvements (figs. 5 and 6).

Arthroscopic stage III is characterized by a more diffuse loss of trapezium joint surface (fig.7). The base of the metacarpal can also present cartilage injuries of varying degrees. Arthroscopic findings show us that the treatment of this joint will be complex, and that debridement and correction osteotomies will prove insufficient for a satisfactory long-term result. In these cases we perform a hemitrapezectomy by burring the remains of the cartilage and going through the subchondral bone until an irrigated plane is reached. This step not only enables us to increase joint space but also allows the formation of an organized thrombus (due to bleeding) that can be adhered to a tendinous graft. This graft can be obtained from the small palmar or from the volar part of the APL and can be inserted through the arthroscopic entry site, as Menon suggested[2]. At present we can replace the tendinous graft with the placement of interposition material called Arthelon® (figs. 8 and 9). A splint that will keep the thumb in abduction position for 4 weeks is placed and subsequently rehabilitation is initiated mainly to improve pinch strength. Stage III can also be treated with a classic open resection arthroplasty[21-24], arthrodesis[16], or prosthesization[25], depending on the surgeon's preference.

Arthroscopic-radiologic correlation

The most constant arthroscopic findings in the group of radiologic stage I patients include partial wear of joint cartilage in the ulnar third of the base of the first metacarpal, injury of the dorso-radial ligament (DRL) and diffuse synovial hypertrophy (fig.1). Another less constant finding is the attenuation of the posterior oblique ligament (POL).

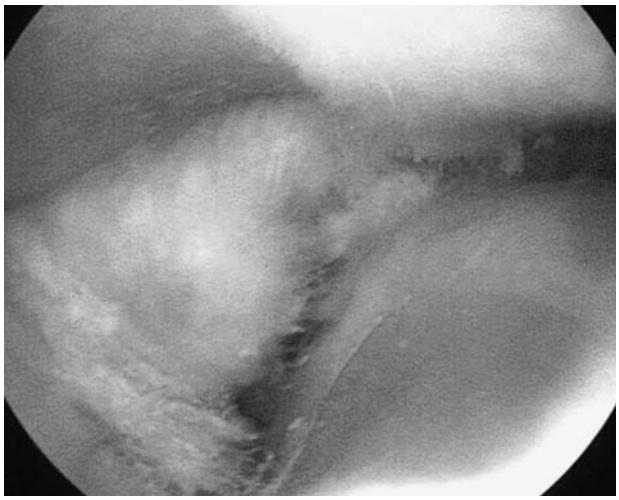

Figure 7. *Arthroscopic stage III includes extensive cartilage loss in both facet joints.*

Figure 8. *Clinical image showing traction method, positioning of arthroscope and Arthelon implant insertion through radial entry site.*

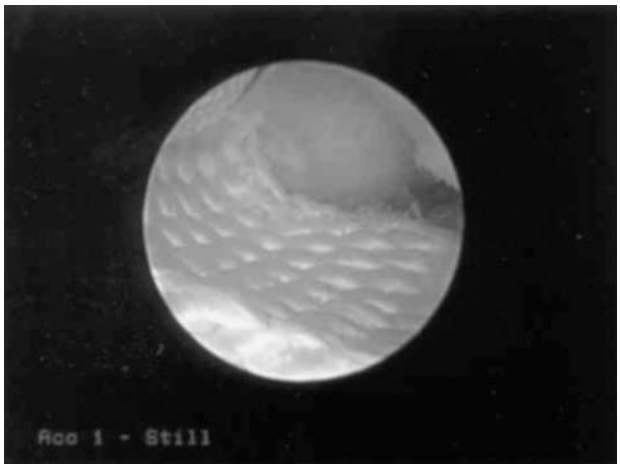

Figure 9. *Arthroscopic view of Artelon implant in position.*

In patients classified under radiologic stage II, we find osteosclerosis in the joint surface of the ulnar third of the base of the first metacarpal and in the central third of the distal surface of the trapezium, with DRL injury, a greater weakening of the POL and a more marked synovial hypertrophy (fig.2). This is correlative with arthroscopic stage II, but we may also find patients in radiologic stage I whose arthroscopic study shows that injuries are more advanced than they appear to be in the X-ray, and thus correspond to arthroscopic group II. As a result of this, we can conclude that the arthroscopic study will confirm what we expect after observing the radiologic findings, and can even show that injuries are more severe than we would expect, whereas the contrary seldom occurs. The condition at this stage can have the greatest impact on the patient's treatment, due to the lack of therapeutic resources. We will therefore comment on the results obtained with these patients in the following pages.

In those patients whose radiologic characteristics are compatible with stages III and IV on the Eaton and Litter scale, the arthroscopic study generally shows great loss of cartilage, in all its thickness and surface, in both facet joints, with or without the presence of a perispheric rim, and with a highly marked synovitis. It also shows completely lax and frayed volar ligaments (fig.7). These findings correspond to arthroscopic stage III for which there are various therapeutic options, such as the choice between an open and an arthroscopic technique. The author of this paper has performed an interposition arthroplasty assisted by arthroscopy.

PRELIMINARY RESULTS FOR STAGE II

The patients that had been diagnosed arthroscopically as stage II in Badía's scale between 1998 and 2001 were examined retrospectively and adequate follow-up was initiated. The group consisted of 43 patients (38 females and 5 males) with an average age of 51years (31 to 69). Twenty-three patients presented with the pathology in the right thumb and 20 in the left thumb. Although conservative treatment had been administered to all of them for 6 weeks, there had been no improvement and it was therefore decided to perform arthroscopy with synovectomy, debridement and occasional thermal capsulorrhaphy. In all cases, a closed osteotomy stabilized with a 0.045" (1.15 cm) Kirschner wire was also performed. An antebrachial short cast was maintained for 4 to 6 weeks, after which the Kirschner wire was removed. Mean follow-up time was 43 months (24 to 64 months).

The most frequent findings in this group of patients included the wear of the joint surface of the ulnar third of the base of the first metacarpal and of the central third of the surface of the trapezium, injury of dorso-radial ligament, weakening of anterior oblique ligament and synovial hypertrophy. All the osteotomies healed in a period of between 4 and 6 weeks. The radiologic study at end of follow-up showed that, in 42 patients, the metacarpal was still centered on the trapezium and there were no changes in the progression of the arthritis. The mean mobility range of the metacarpophallangeal was between 5 and 500, with a thumb opposition that reached the base of the little finger in every case. Pinch strength was 4.2 kg (73% with respect to contralateral). At the end of follow-up, 37 patients felt no pain, 3 referred mild pain, two moderate pain, and the only one that referred persistent pain underwent trapezium resection assisted with arthroscopy due to the progression of his arthritis. These preliminary results suggest that we must continue using this technique, though we have not yet obtained results based on more extensive follow-ups, which would provide an assessment of the technique in the long term and for patients at stage II.

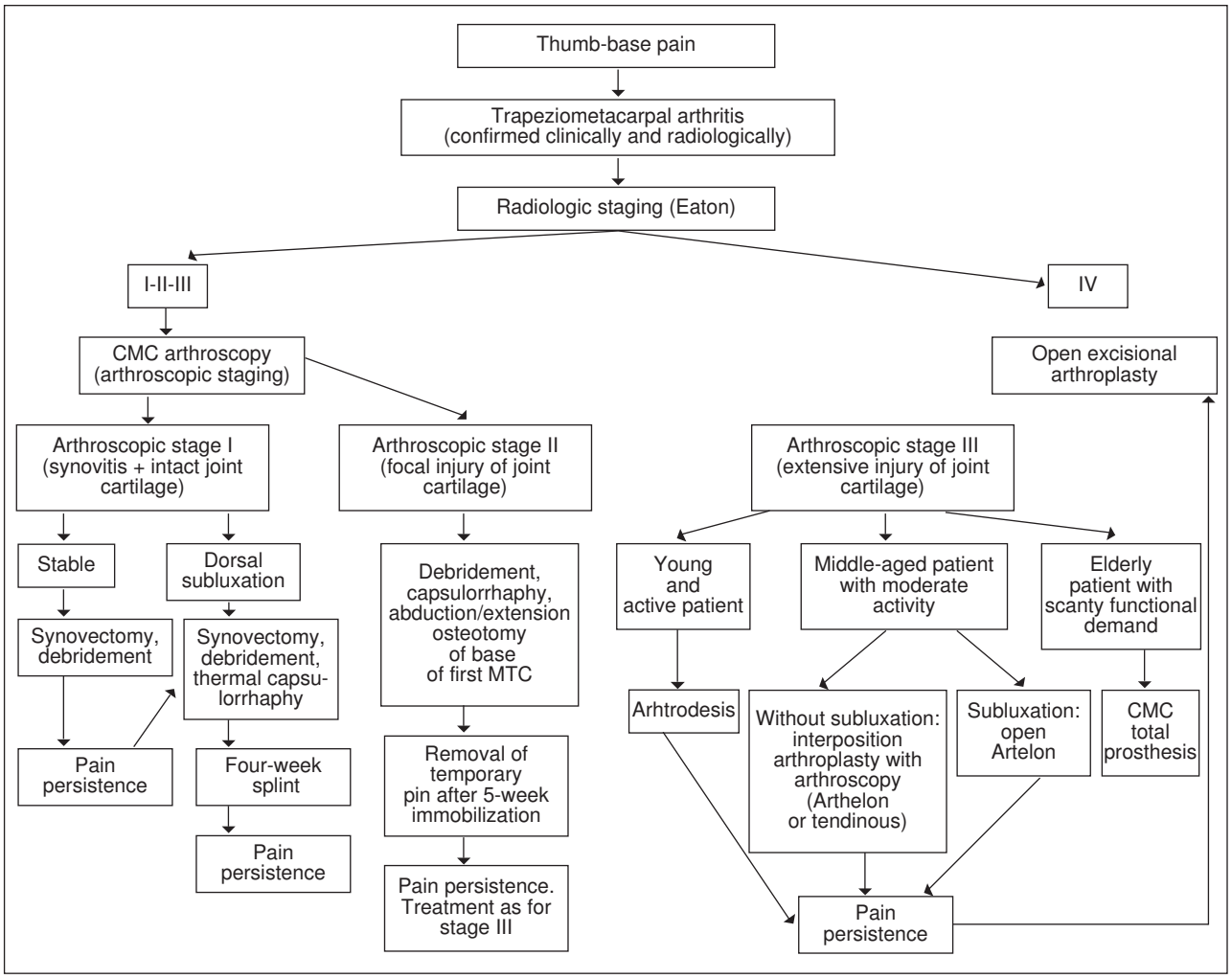

Figure 10. *Suggested protocole for management of trapeziometacarpal arhtritis, considering arthroscopic findings and including recommended treatment. CMC: carpometacarpal; MTC: metacarpal; LRTI: ligament reconstruction and tendon interposition.*

The arthroscopic classification and therapeutic algorithm we present on Table 1 and in Figure 10 are based on the results we obtained and on our clinical experience.

DISCUSSION

In the past, we only counted with clinical and radiologic exploration to assess and decide on treatment for patients with rizarthrosis[26,27]. Eaton and Glickel[15] proposed a classification system that has been widely used. Eventually, Bettinger[28] described the inclination of the trapezium as a means to predict the progression of the condition, and Barron and Eaton[29] also contributed the not very profitable MRi, CT-scan or ultrasound as routine tests for assessing rizarthrosis.

Even though I believe that radiologic classification is useful for assessing the progression of this condition, personal experience has shown me that there are many cases in which it is difficult to establish the actual degree of development of the condition counting only with a radiologic study. Advances in the arthroscopic study of small joints have enabled us to assess their state with a minimum morbidity rate[1], especially in the first CMC, as was stated above[3].

In the initial stages of thumb-base arthritis, those corresponding to stage I on the Eaton scale, we frequently find a simple and normal radiologic study of a patient who presents with pain and functional limitation. We have observed that these patients are highly likely to be middle-aged women that do not favor aggressive surgical treatment[27]. They usually present with acute or moderate synovitis, and may benefit from joint debridement and ligament shrinkage by means of thermal capsulorrhaphy, achieving improved stability. These techniques are notably less aggressive than extensive osteotomy, which

Tomaino[20] suggested for stage I and which may prevent the progression of the condition. If, instead, we are dealing with an arthroscopic stage II with clear wear of the cartilage, then we are bound to need a technique that will modify joint biomechanics, such as osteotomy. In my retrospective study of 43 patients that had undergone osteotomy, only one presented with progression of the condition and needed to be operated on again.

When arthroscopic findings show a complete joint injury, there is no doubt that treatment will include some kind of trapezectomy with interposition arthroplasty. This is true both for partial and complete resections. Menon[2] described the debridement of the TMC joint surface through arthroscopy and the placement of an interpositional plasty with fascia lata, tendon or Gore-Tex patches in patients in stages II or III, these being techniques that obtained excellent results. New techniques allow us to insert Arthelon (Small Bone Innovations, New York), whose efficacy has been shown in open techniques and histologically[30]. Furthermore, it prevents us from performing the scission of the trapezium, this being especially significant in young patients. We have not yet evaluated the long-term results.

Basing ourselves on Badía's arthroscopic classification, we recommend synovectomy and arthroscopic debridement in the cases of thumb-base arthritis in stage I. For stage II, the same treatment is recommended but with the addition of osteotomy of the first metacarpal with the aim of improving joint biomechanics. A capsular shrinkage by means of radiofrequency can be performed in both stages I and II, if the state of the joint ligaments requires it. Finally, the procedure recommended by Dr. Badía for stage III is interposition arthroplasty with arthroscopy.

In conclusion, we wish to highlight the fact that the use of arthroscopy for the assessment of the TMC joint enables the visualization of all the joint components, including the synovial sheath, joint surfaces, ligaments and the joint capsule. This allows us to obtain a more precise estimate of the stage of the condition. I recommend the use of arthroscopic staging, as described here, as an aid in deciding which is the best therapeutic option for patients with this incapacitating condition.

Future publications of studies of long-term results of arthroscopic procedures will very likely confirm its usefulness as a possible treatment for TMC arthritis.

REFERENCES

1. Chen YC. Arthroscopy of the wrist and finger joints. Orthop Clin North Am. 1979;10:723-33.
2. Menon J. Arthroscopic management of trapeziometacarpal joint arthritis of the thumb. Arthroscopy. 1996;12:581-7.
3. Berger RA. A technique for arthroscopic evaluation of the first carpometacarpal joint. J Hand Surg Am. 1997;22A:1077-80.
4. Osterman AL, Culp R, Bednar J. Arthroscopy of the thumb carpometacarpal joint. Arthroscopy. 1997;13:411.
5. Weitbrecht J. Syndesmology (1742). Philadelphia: WB Saunders; 1969.
6. Bettinger PC, Linscheid RL, Berger RA, Cooney WP III, An KN. An anatomic study of the stabilizing ligaments of the trapezium and trapeziometacarpal joint. J Hand Surg Am. 1999;24A:786-98.
7. Van BB, Richards RR, Mackay MB, Boynton EL. A biomechanical assessment of ligaments preventing dorsoradial subluxation of the trapeziometacarpal joint. J Hand Surg Am. 1998;2A:607-11.
8. Zancolli EA, Cozzi EP. The trapeziometacarpal joint: anatomy and mechanics. En: Zancolli E, Cozzi EP, editores. Atlas of surgical anatomy of the hand. New York: Churchill Livingstone; 1992. p. 443-4.
9. Xu L, Strauch RJ, Ateshian GA, Pawluk RJ, Mow VC, Rosenwasser MP. Topography of the osteoarthritic thumb carpometacarpal joint and its variations with regard to gender, age, site, and osteoarthritic stage. J Hand Surg Am. 1998;23A: 454-64.
10. Pellegrini VD Jr. Pathomechanics of the thumb trapeziometacarpal joint. Hand Clin. 2001;17:175-8.
11. Bettinger PC, Berger RA. Functional ligamentous anatomy of the trapezium and trapeziometacarpal joint (gross and arthroscopic). Hand Clin. 2001;17:151-68.
12. Orellana MA, Chow JC. Arthroscopic visualization of the thumb carpometacarpal joint: introduction and evaluation of a new radial portal. Arthroscopy. 2003;19:583-91.
13. Walsh EF, Akelman E, Fleming BC, DaSilva MF. Thumb carpometacarpal arthroscopy: a topographic, anatomic study of the thenar portal. J Hand Surg Am. 2005;30A:373-9.
14. Culp RW, Rekant MS. The role of arthroscopy in evaluating and treating trapeziometacarpal disease. Hand Clin. 2001; 17:315-6.
15. Eaton RG, Glickel SZ. Trapeziometacarpal osteoarthritis: staging as a rationale for treatment. Hand Clin. 1987;3:455-71.
16. Fulton DB, Stern PJ. Trapeziometacarpal arthrodesis in primary osteoarthritis: a minimum two-year follow-up study. J Hand Surg Am. 2001;26A:109-14.
17. López MJ, Hayashi K, Fanton GS, Thabit G III, Markel MD. The effect of radiofrequency energy on the ultrastructure of joint capsular collagen. Arthroscopy. 1998;14:495-501.
18. Hecht P, Hayashi K, Cooley AJ, Lu Y, Fanton GS, Thabit G III, et al. The thermal effect of monopolar radiofrequency energy on the properties of joint capsule: an in vivo histologic study using a sheep model. Am J Sports Med. 1998;26: 808-14.
19. Wilson JN, Bossley CJ. Osteotomy in the treatment of osteoarthritis of the first carpometacarpal joint. J Bone Joint Surg Br. 1983;65B:179-81.
20. Tomaino MM. Treatment of Eaton stage I trapeziometacarpal disease. Ligament reconstruction or thumb metacarpal extension osteotomy? Hand Clin. 2001;17:197-205.
21. Eaton RG, Glickel SZ, Littler JW. Tendon interposition arthroplasty for degenerative arthritis of the trapeziometacarpal joint of the thumb. J Hand Surg Am 1985;10A:645-54.
22. Burton RI, Pellegrini VD Jr. Surgical management of basal joint arthritis of the thumb. Part II: ligament reconstruction with tendon interposition arthroplasty. J Hand Surg Am. 1986;11A:324-32.
23. Tomaino MM, Pellegrini VD Jr., Burton RI. Arthroplasty of the basal joint of the thumb. Long-term follow-up after ligament reconstruction with tendon interposition. J Bone Joint Surg Am. 1995;77A:346-55.

24. Lins RE, Gelberman RH, McKeown L, Katz JN, Kadiyala RK. Basal joint arthritis: trapeziectomy with ligament reconstruction and tendon interposition arthroplasty. J Hand Surg Am. 1996;21A:202-9.
25. Braun RM. Total joint replacement at the base of the thumb–preliminary report. J Hand Surg Am. 1982;7A:245-51.
26. Froimson AI. Tendon arthroplasty of the trapeziometacarpal joint. Clin Orthop. 1970;70:191-9.
27. Swigart CR, Eaton RG, Glickel SZ, Johnson C. Splinting in the treatment of arthritis of the first carpometacarpal joint. J Hand Surg Am. 1999;24A:86-91.
28. Bettinger PC, Linscheid RL, Cooney WP III, An KN. Trapezial tilt: a radiographic correlation with advanced trapeziometacarpal joint arthritis. J Hand Surg Am. 2001;26A: 692-7.
29. Barron OA, Eaton RG. Save the trapezium: double interposition arthroplasty for the treatment of stage IV disease of the basal joint. J Hand Surg Am. 1998;23A:196-204.
30. Nilsson A, Liljensten E, Bergstrom C, Sollerman C. Results from a degradable TMC joint Spacer (Artelon) compared with tendon arthroplasty. J Hand Surg Am. 2005;30A: 380-9.

Conflict of interests

Dr. Badía is Vicepresident of the *Surgeon Advisory Board of Bone Innovations*. Dr. Plaza has declared having no conflict of interests.