OSTEOCHONDRITIS DISSECTANTS: A CURRENT LITERATURE REVIEW

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Abstract: *Osteochondritis dissecans is a disease that appears more frequently in young men, at the knee level, and with a better prognosis at these early ages. Its etiopathogenesis is considered multifactorial, influencing the interaction of constitutional aspects and metabolism, with other mechanics (the latter being, such as microtrauma, currently more relevant). Pain on loading is the most frequent symptom (80%), and for its diagnosis we will rely on simple X-rays, Computed Tomography (CT) and Magnetic Resonance Imaging (MR), but the gold-standard is arthroscopic. Regarding the treatment of the disease, first attempts are made to act with conservative therapies, and later surgery becomes important. There are two blocks of surgical treatment: reparative (in situ fixation techniques, micro-/nanoperforations) and substitution (autologous bone graft, osteochondral grafts of various kinds, chondrocyte cultures and, as a last option, arthroplasty). In the literature there is great discussion about management, which depends mostly on factors such as the size of the lesion, the functional demand of the patient or age; however, there is no consensus, and each author usually proposes a different algorithm. Neither has strong enough evidence been found in the literature to recommend a specific treatment, although it is true that autologous chondrocyte culture seems to be a very promising option when it is fully developed. If there is something certain in this disease, it is that the deformity that causes it (if any) must be treated first, and the treatments adapted and individualized, so that we do not over-/under-treat patients.*

Key words: *osteochondritis dissecans, osteochondritis.*

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INTRODUCTION

We know that the diarticular surfaces present hyaline cartilage, and that this is composed of chondrocytes (cells that live in borderline conditions, such as low oxygen content) and the matrix, with variable proportions of collagen, elastin, and other substances. Just below that cartilage we find the subchondral bone, with characteristics of trabecular/cancellous bone. In the disease known as osteochondritis dissecans

(OCD), a degeneration of the subchondral bone is produced by different mechanisms that end up hindering the nutrition of the articular cartilage. This disruption can generate cartilage involvement, bone necrosis and finally, the release of the fragment due to subchondral bone fracture, that is, intra-articular free bodies are produced.

The final consequence will be osteoarthritis, which in most cases appears early.
The most frequent locations are the
knee, ankle and elbow (in order of incidence).

HISTORY

Before addressing the disease, and as a curiosity, we will make a paragraph for the term origin know the
osteochondritis.

The first description of a pathology that could be understood as OCD was made in 1558 by Ambroise Paré, the French "Father of Surgery",(1) when writing about the removal of free bodies within the joints. However the term OCD

was coined by Franz König in 1887, in his article "The Classic On Loose Bodies in the
Joint". In it, he elaborated a monologue about free intra-articular bodies in the elbow and knee. It described patients with joint involvement of

characteristics inflammatory, whose symptoms subsided once the free bodies were extracted, which he found by chance in some of his surgeries(2) .

ETIOPATHOGENESIS

There are many theories about it, but none is strong enough on its own to be considered the cause. The following algorithm, proposed for the knee by Andriolo L. et al. explains the necessary interaction between all

factors that we will break down one by one, and in which both biological and mechanical mechanisms influence (3) [Figure 1].

Biological factors. These three factors end up affecting bone remodeling.

- ÿ Genetic factors such as the ACAN gene protein, or collagen mutations.
- ÿ Endocrine factors in relation to
  changes in hGH or metabolism
  vitamin D. These alterations
  they are generally framed within systemic syndromes.
- ÿ Ossification deficit theory
  endochondral: this type of ossification is the one that occurs in long bones. In OCD there would be an incomplete connection between the vascular systems of the ossification center

  secondary, which could lead to a

weaker trabecular bone, unable to resist small forces. Care must be taken, because in the case of young patients with active physis, it can be confused with variants of normal ossification (4)

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factors mechanics provoke trauma to the subchondral bone.

ÿ Repeated microtrauma, since it has been seen that a single macrotrauma is not associated with this pathology. ÿ Compression and impingement of the tibial spine during internal rotation of the knee while a load is produced with flexion of the knee. This theory was the one defended by Fairbank in 1933. ÿ Biomechanical alterations caused iatrogenically (meniscectomy) and constitutional others (genu recurvatum, flattening of the condyles, cruciate agenesis, varus/valgus misalignments, or increased tibial slope). ÿ Discoid meniscus, as a peculiarity of the knee, which produces overload of the subchondral bone favoring the release of the fragment to joint. the

These injuries add up to the cascade etiological, causing the subchondral bone and cartilage to isch and ultimately fracture. To support the theory of subchondral necrosis Shea at al. study various histological samples and detected that this could be secondary to ischemia of the terminal epiphyseal blood vessels (5). Many of these theories could be extrapolated to other locations.

In the aforementioned article by Andriolo L., he reflects that over time, various authors have been describing what in their opinion and based on the evidence, was the origin of this pathology. However, in recent years, there has been a great rebound that directs it towards mechanical factors that end up fracturing the subchondral bone [Figure 2].

To end this section, we will say that there is something that we certainly do not find in the histology of free bodies: inflammation. Barrie in 1984 already denied that (despite the inflammatory symptoms described by König), histology revealed no inflammatory findings.

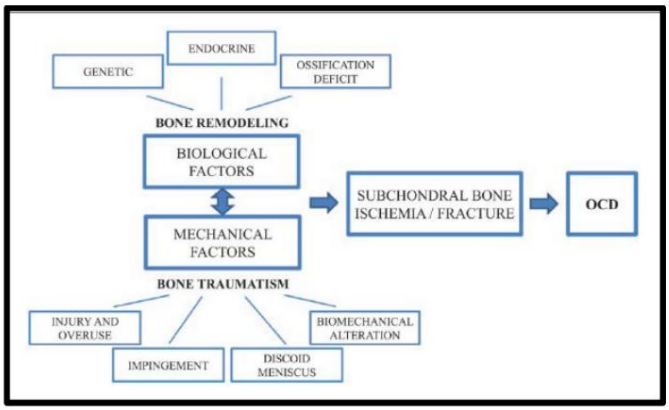

Figure 1. Etiopathogenic mechanism of osteochondritis dissecans of the knee, proposed by Andriolo L., et al.

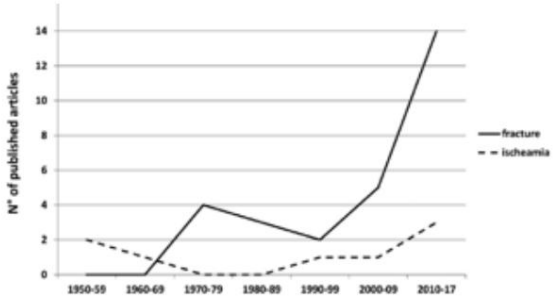

Figure 2. Evolution of scientific publications on the aetiology of osteochondritis.

DIAGNOSIS

Suspecting this pathology is going to be quite complex, therefore, Table 1 summarizes the most relevant epidemiological characteristics presented by the patients, for each of the OCD locations.

It should be noted that it is a pathology of adolescent men, mostly, and that OCD of the ankle is the only one that does not seem to have a predilection for sex, indeed, in some series they comment on a certain predilection for the female sex. Also for the ankle, a not insignificant number of cases of OCD have been found as a sequel to a traumatic ankle sprain (it generally causes displacement of an already pathological fragment that makes OCD symptomatic in 6.8% of the cases that generally occur in the lateral talar dome).

HISTORY AND PHYSICAL EXAMINATION

The first thing we have to take into account to suspect and diagnose OCD is to take a good history

asking about recent trauma, increased level of activity, existence

of previous injuries or the presence of mechanical symptoms.

As for the symptoms that the patients will present, the most frequent will be pain on load (80%; of an intermittent, mechanical and poorly located type) that can be present up to 14 months before diagnosis. In other cases, they may present with swelling (20%), crepitus, limitation of movement and blockages (free bodies), which suggests that the fragment will be unstable and the disease is already advanced, debuting in this way in 20% of cases. the

cases.

exist particularities according to location:

- Knee – Wilson test: it is placed at the patient on stretcher with legs hanging at 90º. We ask the patient to extend the knee while we hold with the foot to internally rotate. Normally the

  The patient will feel pain at about 30º (due to spinal impingement), which will disappear once they are in neutral or external rotation. It has been seen

  that this sign is quite non-specific (positive in 16%) and has no clinical validity according to the evidence. It will always be necessary to make a difference diagnosis with femoro-patellar and meniscal pathology.

- Elbow – prono-supination: pain on palpation of the radius capitellar articulation during prono-supination with the elbow in extension. In this case

  a differential diagnosis must be made with epicondylitis and radial head fractures.

INCIDENCIA	6-29 casos/100.000 hab. /año	0.7-8.9 casos/100.000 hab. /año	2.2-3.8 casos/100.000 hab. /año
EDAD	12-19 años		
LOCALIZACIÓN	**Cóndilo femoral medial** (porción posterolateral)	Carilla articular medial del **astrágalo**	**Cóndilo humeral** (capitellum)
LATERALIDAD	Miembro dominante	Bilateralidad poco frecuente	
SEXO	♂>>>>♀	♂≤♀	♂>>♀
RAZA	Negra	Caucásica	Caucásica
ASOCIACIÓN	Microtraumatismo repetido	Esguince de tobillo traumático	Microtraumatismo repetido

Table 1. Epidemiology of OCD according to location. (6–8)

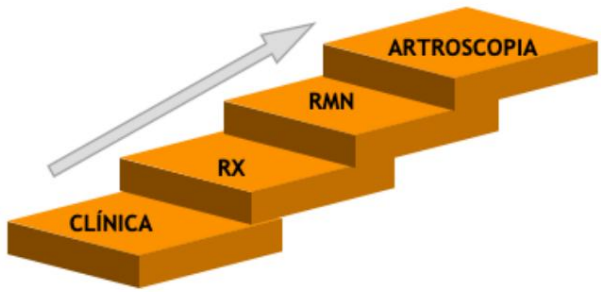

Figure 3: suggested diagnostic algorithm.

RADIOLOGY

This tool is basic in the daily work of the orthopedic surgeon. Below are images of patients diagnosed with OCD by plain radiographs or CT [Figures 4 and 5]. It is important to assess the contralateral joint to compare and notice minimal alterations.

- Knee – AP, lateral and tunnel/"notch"/ Roosemberg views: the latter is best for assessing the medial and posterior portion of the femoral condyles (this is a AP at 45º flexion), as well as it is also used for the assessment of osteoarthritis.
- Ankle – AP, lateral and mortise: also in this case, the specific mortise projection allows full assessment of the articular surface.
- Elbow – AP, lateral and AP at 45º of flexion: they are only positive in 66% of cases and a differential diagnosis will have to be made with the disease of Panner (idiopathic and atraumatic osteochondrosis of the capitellum, generally in patients under 10 years of age and which is self-limiting.

CT, being one of the most important tools in the diagnosis of bone fractures, is not systematized in the diagnosis of OCD. There are hardly any current articles that relate the use of CT in OCD, and it is mainly because the disease occurs in young patients with open physes and large proportions of cartilage, not easily visualized by CT. However, the study by van den Ende(11) concludes that the CT is the proof

that better diagnoses intra-articular free bodies in OCD of the elbow, and that could also be extrapolated to other locations.

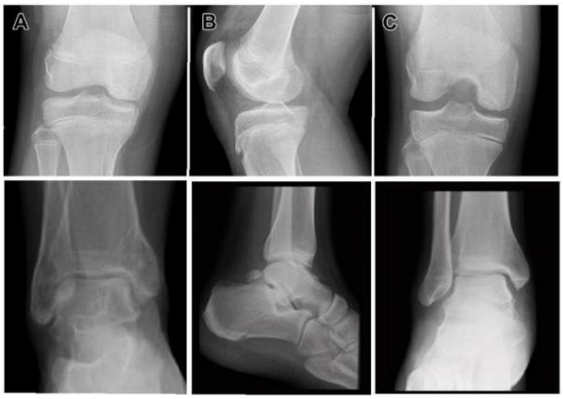

Figure 4. AP (A), lateral (B) and specific (C; tunnel above, mortise below) view in OCD of the knee and ankle. Images obtained from the work of Grimm N., et al. (9)

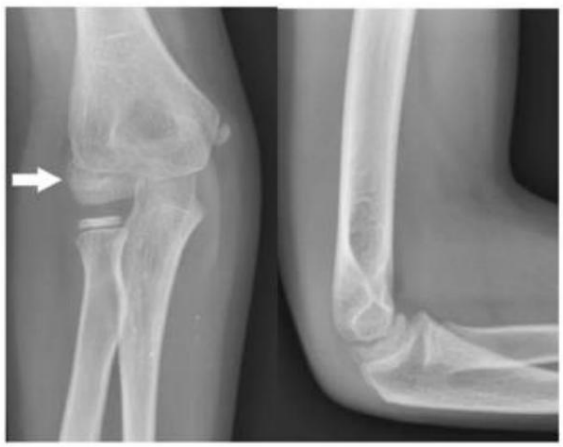

Figure 5. Panner's disease of the elbow. Monitor the differential diagnosis of OCD. Images obtained from the work of García Cañas R., et al. (10)

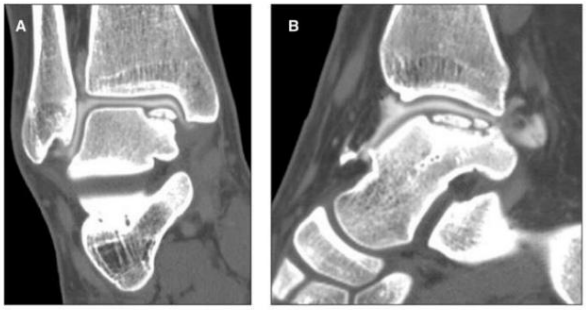

Figure 6. CT of the ankle with intra-articular contrast. We can assume that there is no cartilage tear despite the osteochondral lesion that is evident since the contrast does not leak below the lesion.
Images obtained from the work of Bauer KL, & Polousky, JD (12)

MAGNETIC RESONANCE

Is a of the more useful complementary examinations to assess the stability of the lesion, and a series of criteria have also been established for this(12). In magnetic resonance, much more sensitive for the diagnosis of osteochondritis, a T2-weighted sequence is used (the fluid looks white), in this way we will observe the edema

surrounding the lesion as well as an edge characteristic hyperintense (under normal conditions, in this sequence, both normal subchondral bone and cartilage present low signal). Therefore, a lesion will be unstable when it presents any of the following characteristics: - Subchondral cysts

- Well-defined lesion
- High signal intensity on T2
- Fracture of the overlying cartilage

This test presents a 100% sensitivity for lesions in the patient

adult, however, in young patients (the majority of those affected), it is reduced to 11% for juvenile OCD of the knee.

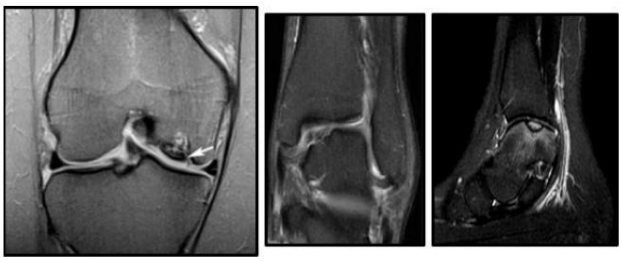

Figure 7. MRI of the unstable lesion in the coronal view of the knee (left) and in the coronal and sagittal view of the ankle (center/right). Images taken from the work of Grimm N., et al. (9) and Bauer KL, & Polousky, JD (12)

ARTHROSCOPY

Arthroscopy is the main method to establish the diagnosis to date, however, there is no single classification for all the locations described, nor is there a consensus within each of them. We will talk about the most used or the

What is most relevant today:

Berndt & Harty Classification (1959) [13].
This classification was established for the talar dome in the ankle joint by means of plain radiographs, and was later revised for arthroscopy.

It consists of four stages depending on the stability of the lesion [Figure 8]:

- ÿ Stage 1. Osteochondral fracture due to sinking.
- ÿ Stage 2. Fragment joined by bone bridges. ÿ Stage 3. Fragmentally free, not displaced. ÿ Stage 4. Displaced fragment.

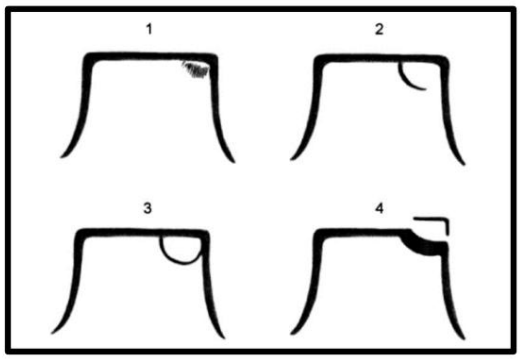

Figure 8. Berndt & Harty (1959) classification.

Classification of the International Cartilage Repair Society (ICRS; 2003) (14). This classification is the most up-to-date.

moment and one of the most used when assessing cartilage defects, also applicable in the case of OCD, divided into 5

degrees depending on the depth of the defect [Figure 9]: ÿ Grade 0. Normal cartilage. ÿ Grade 1. Superficial affectation.

Arthroscopically we could notice the cartilage intact but softened. ÿ Grade 2. Solution of continuity of the

cartilage of <50% of the depth.
Both stage 1 and 2 are
stable when tested in the
arthroscopy. That is, they are low-grade injuries.

ÿ Grade 3. Affectation of more than the

half the thickness of the cartilage. In arthroscopy we would see a complete discontinuity but with a non-dislocated fragment. ÿ

Grade 4. Defects that reach the bone trabecular subchondral.
We also generally find

free bodies during arthroscopy.

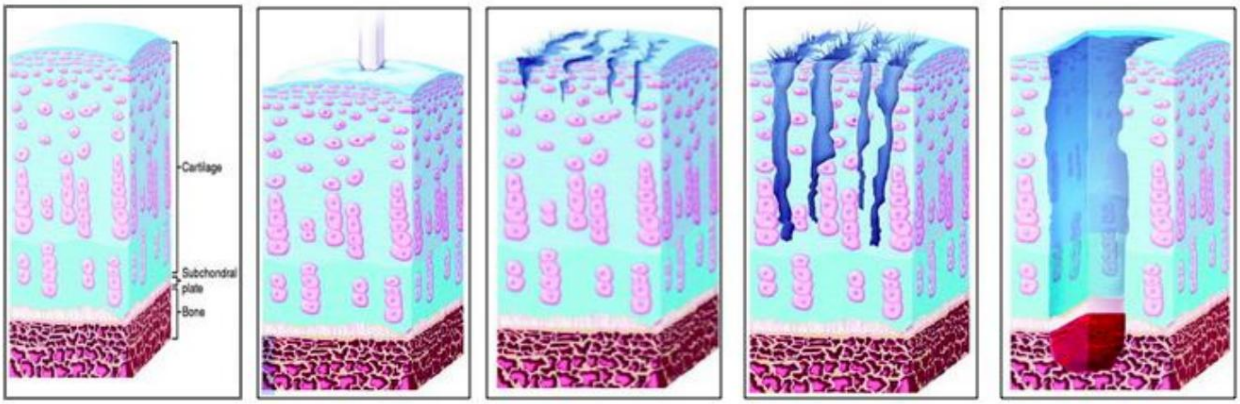

Figure 9. ICRS classification. Grade 0 (top), rest (bottom) in order of severity (from left to right).

Classification of the Research in Osteochondirtis of the Knee (ROCK group; 2016) (15). In view of the great diversity of classifications found in the literature (each one based on a diagnostic tool), the ROCK group has tried to create an arthroscopic classification that can serve as a basis for predicting results. It is based on whether the lesion is mobile or not, as well as on the characteristics of it once perform arthroscopy. It has been validated, and presents good intra- and inter-observer agreement.

TREATMENT

We enter the most controversial section Of the review. There are countless techniques for the treatment of chondral and osteochondral lesions, so we will include them depending on the nature of the treatment (conservative, repairing or reconstructive). Although these lesions are usually treated, sometimes with follow-up and later evaluation of the development of the osteochondral lesion, it is sufficient. (16)

When choosing one treatment or another we will base ourselves mainly on this four characteristics: age of the patient, size of the lesion, activity of the patient, and stability of the lesion. Broadly speaking, in those with symptoms but without joint involvement, also in patients with skeletal immaturity (since young patients have a better prognosis) and, of course, stable fragments, conservative treatment can be chosen.

If this fails, surgical treatment will be chosen, which in many cases is the main indication (17).

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CONSERVATIVE TREATMENT (18)

This will be the treatment of choice in Young patients, with intact cartilage or lesions <2 cm2 , and that are located in the classic location for each joint, and although strong evidence on this subject is lacking, they usually resolve after 6 months of treatment. The following treatments are included within this block, none of which has proven superior over another, and they are usually used together (they have not shown efficacy either):

or Physiokinesotherapy. It consists of local heat and/or manual therapies.

o Muscle strengthening.

o Restriction of physical activity.

or physical therapies. Ionophoresis, US, shock waves… or

Immobilization and full load reduction/limitation. In the case of the elbow, immobilization is not recommended to avoid stiffness.

SURGICAL TREATMENT

Before starting treatment surgical treatment of OCD lesions, it should be noted that there are no established criteria to opt for one or the other, and that it will be the experience of the surgeon, and in many cases, the characteristics of the patient and the lesion, which will make us opt for one. determined option.

In figure 10 we can see the treatment strategy for chondral and osteochondral lesions proposed by Vaquero and Forriol (2012) taking into account various characteristics (19).

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restorative treatment. Below we will describe treatments that seek to repair the defect created by OCD, especially in patients with sufficient bone stock and lesions, most of which are stable.

On-site fixation (twenty). This treatment seeks to fix the osteochondral fragment to the bone from which it comes. It can be done in two ways without it having been proven that one is better than the other:

ÿ Transarticular, by via arthroscopic.

ÿ Retroarticular, with fluoroscopic control. They are more technically difficult.

In situ screw fixation (cannulated or not) of the articular cartilage is preferred for cases of unstable OCD (as long as there is sufficient underlying bone), even with Kirschner wires. sometimes it's necessary

remove them and check the healing with a second time.

microperforations (21): This The therapeutic option is based on trying to revitalize the bed on which the osteochondral lesion is based. First, the cartilage is debrided arthroscopically and then perforations about 3mm deep are made along the subchondral bone of the pathological area to achieve controlled bleeding.

There is currently more support for nanoperforations, finer and deeper (up to 9mm) that better reach the bone marrow of the long bone, which will provide hematopoietic cells that could end up generating a chondrosimilar matrix.

In addition, we can associate this technique with others to improve the results, as shown in figure 11, with a protection clot.

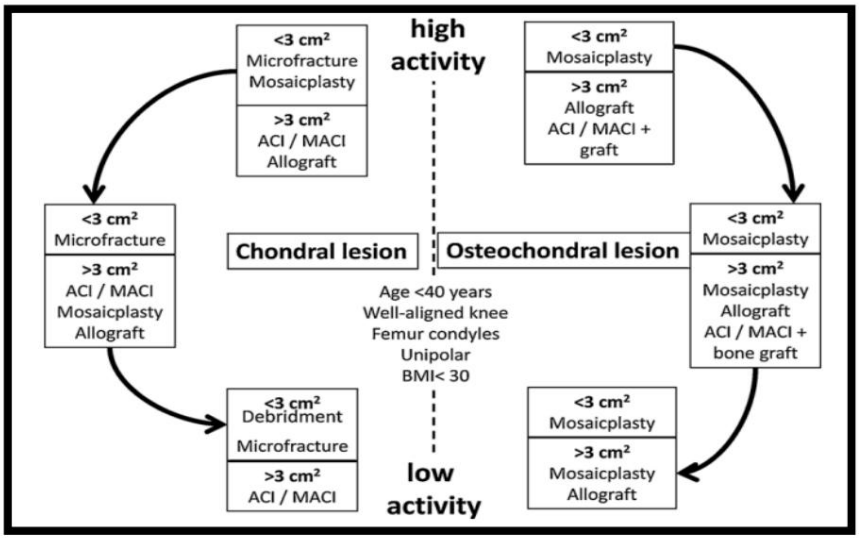

Figure 10. Treatment algorithm by Vaquero, J., & Forriol, F. (2012) for ocndral knee injuries. In this algorithm they establish a limit of 3 cm2 .

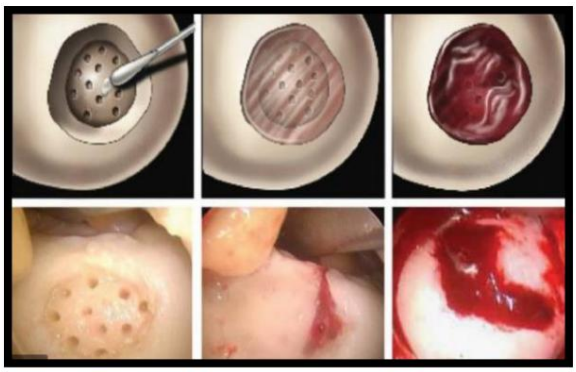

Figure 11: Protection of the clot with a cartilage matrix to retain bleeding and hematopoietic cells. Image obtained from the work of Shive MS., et al. (22)

Autologous bone graft. It could be a treatment halfway between substitutes and repairers, since it consists of obtaining small fragments of trabecular bone and implanting them on the surface of the bone defect. Subsequently, once consolidated, we could consider cartilage repair using other replacement techniques.

Substitute treatment. It is the attitude that we should have in the face of the most advanced that we cannot save with "self-repairing" treatment. In these cases it will be necessary to help the organism to fill in the defect that has been created (generally once the fragment is unstable and has detached). In this regard, science does not stop advancing and improving with innovative techniques, or applying new qualities to those currently implemented.

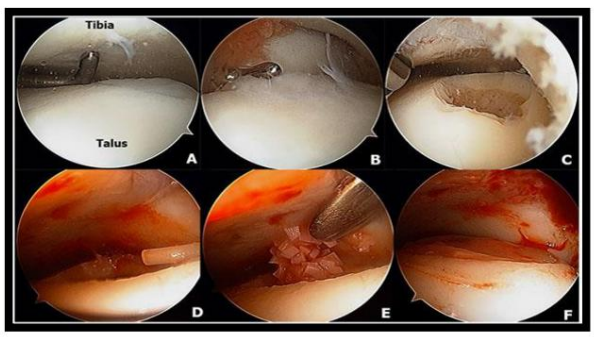

Figure 12: Autologous bone graft for repair of the talar defect. Image obtained from the work of Rungprai C., et al. (23)

The use of bone marrow aspirate has also been considered (functioning in a similar way to microperforations).

Osteochondral graft. This Treatment is reserved for larger cartilaginous lesions, especially when we cannot save the fragments, or when previous treatments have failed. The techniques

Extraction/implantation procedures present great technical difficulty, and can come from various sources. A characteristic of the ankle is that it is a very congruent load-bearing joint, and access to the talus will sometimes require a fibular osteotomy. Next we will talk about the

their advantages and disadvantages:

autologous Grafts are usually taken from the upper part of the ipsilateral knee condyle (usually the lateral condyle), regardless final destination of the graft). Within this technique, there is mosaicplasty, which consists of implanting several cylinders, with greater overall graft survival, however [24] [Figure 13], the spaces between them are never filled. Other features of this

type of graft are:

- Low joint congruence
- Morbidity of the donor area
- limited
- accessible
- High survival (short/medium term)

Allogeneic. They arose later and to solve the problem with autologous grafts, but nevertheless, they are only used when it is necessary to replace large osteochondral fragments and in very congruent joints (ankle).

Other disadvantages of this technique are that diseases can be transmitted (grafts preserved "fresh") and that they generally survive[25] . have little

Synthetic. It is a technique novelty still and little studied in which biphasic cylindrical scaffolds are placed made up of synthetic copolymers that facilitate the defect filling technique osteochondral. However, it presents problems such as pain and persistent effusion, as well as the non-incorporation of the cylinder in the long term. [26].

Chondrocyte culture . Is considered a promising treatment in the coverage of isolated chondral lesions, but which has been included in the treatment of osteochondritis in view of the good short-term results term in a meta-analysis for osteochondral ankle lesions by Niemeyer P., et al. [27]

- 1st generation or ACI (autologous chondrocyte implantation). The technique consists of biopsying the articular hyaline cartilage in a first stage and after washing the chondrocytes they are cultured and, in a second stage, they are implanted once the adequate number of cells has been obtained. Finally I know

  covered with a membrane

periosteum, which is sutured to healthy cartilage and sealed with fibrin. This technique gave hypertrophy problems of the periosteum.

ÿ 2nd and 3rd generation or MACI (matrix associated chondrocyte implantation). To improve complications, they were cultured in a type I/III porcine collagen membrane or by means of a chondroconductive matrix[28], however, their application for osteochondritis requires that the subchondral bone be intact, so it is sometimes necessary for them to be used in association with a cancellous bone graft.

- 4th generation. Still under investigation, it is based mainly on gene therapy and other matrices are being sought

durable, with better integration, greater resistance and better

Arthroplasty. As a last resort joint replacement with a prosthesis (and even arthrodesis) can be considered. This will be the salvage option for defects that could not be repaired with other techniques, and when indicated by the clinic. In this context, the work of Álvarez E., et al. performs an algorithm based on the size of the lesion and rescue options in the event of previous treatment failure; as a last resort, it proposes the option of arthroplasty(30). It will not always be necessary to replace it with a total prosthesis, results have been studied also with unicompartmental knee and ankle prostheses with good results, but low level of evidence. (31)

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OTHER TREATMENTS

Lastly, talking about treatments encompassed perhaps within treatments conservatives either rehabilitators, with doubtful efficacy and low level of evidence. In literature we can techniques find articles with promising but not tested on a large scale, among which are:

o Intra-articular infiltrations with Pÿ PRP. One study defends that it is superior to Lÿ PRP (contains leukocyte platelets) and osteochondral lesions in of the articular bone, and relates this superiority to the inhibition of the cascade of

signaling osteoblastic PI3K/AKT/AP-1 thus reducing the secretion of MMPÿ9 (metalloproteases) (32). However, there are no comparative studies with other methods.

or shock waves. There is a treatment with LIPUS (low-intensity pulse ultrasound) for osteochondritis for of the capitellum tested in a study, in which patients improved their recovery period as observed by image(33). However, it is not clear if it is due to by the direct effect of the shock waves, or due to the decrease in activity.

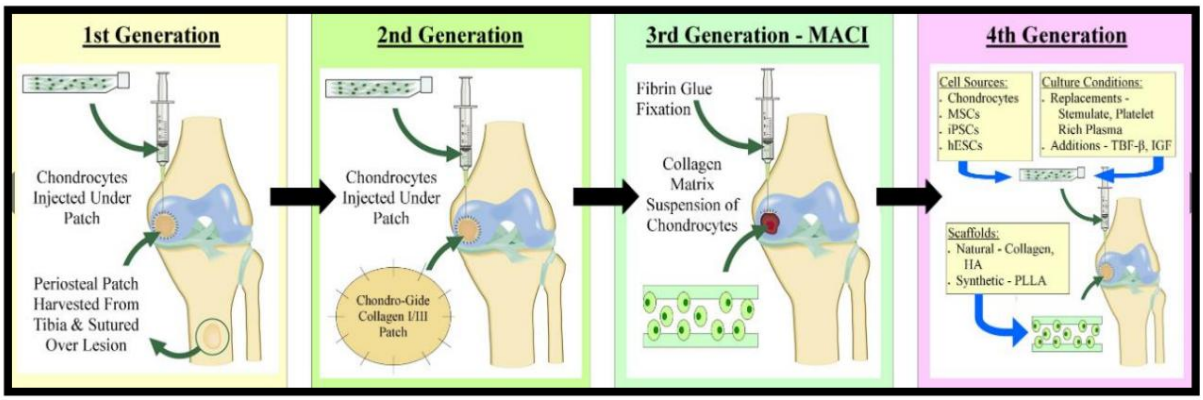

Figure 14. Technical and bioengineering evolution of chondrocyte culture for chondral lesions. Image obtained from the work of Davies, RL, & Kuiper, NJ (29)

o Early loading. The work Min W., et al. defends that they found no differences (VAS and AOFAS scales) between the patients who loaded from the first day after treatment of osteochondral lesion by

microfractures, compared to those that rested after the month of surgery(34) .

DISCUSSION

To finish, and as concepts that we have to be clear about with respect to osteochondritis, we highlight the following points:

ÿ It is a pathology that can go unnoticed if we do not suspect it.
The sooner it is diagnosed, the less measures will be taken.
aggressive, since the treatment must be proportional to the injury, to avoid osteoarthritis.

ÿ In young people, a technique with good long-term results is preferred.

ÿ In Professional athletes will opt for immediate results and speedy recovery.

ÿ There is currently no evidence of that no treatment is better than another, although in a young population, practically all the techniques show satisfactory results

short term (including conservative treatment) (20.35).

We must also know the concomitant pathology of the patient, treat it as a whole, especially so that the patient improves biomechanically.
First we will treat possible deformities, and later the chondral or osteochondral defect.

For all of the above,
we believe it is necessary to develop controlled clinical trials with long-term follow-up in order to establish powerful clinical practice guidelines, since we currently do not have evidence of this level.
Well luck for orthopedic surgery professionals, today we can find many

trials in progress.

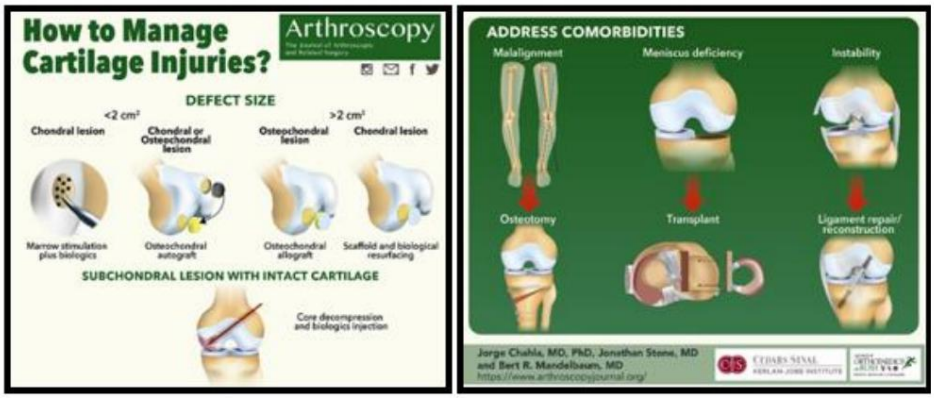

Figure 15. Treatment algorithm proposed by Chahla J., et al. for osteochondral knee lesions, including management of comorbidities. (36)

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