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The Role of the Radiological Parameters in the Diagnosis of the Ankle Joint Fractures

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ABSTRACT

The ankle stability and its biomechanics can be compromised after ligamentous and malleolus lesions. The complete early diagnosis, and also the early and late postsurgery results, must be formulated and explained using the tibio-astragalus radiologic indices. The paper evaluates the importance of these presurgery and postsurgery indices, analyzing also the late results under causal report. Our subordinating to the exigency of radiologic indices to obtain a reparation as anatomic as possible, shows that the surgical treatment must be applied to osteo-ligamentous lesions properly, so that to get the remake of tibio-astragalus biomechanics.

Keywords: ankle, malleolus, fracture, radiology

Introduction

Considered as the most common articular fractures, the malleolar fractures compromise the ankle biomechanic, being an important cause of the tibio-astragalus arthrosis. The traumatism can affect the joint due to osteo-ligamentous lesions, which must be treated, respecting the anathomical parameters which can be evaluate using the radiological parameters [1,2].

The malleolar fractures and the associated ligamentous lesions can modify the joint by affecting the biomechanical function, resulting as consequence the necessity of a complex dyagnosis and an adecvate therapeutical solution [3].

We propose to analyse the importance of the tibio-astraglian radiological parameters, in concordance with the initially dyagnosis, the therapeutical possibilities and the late results.

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Materials and Methods

1. The casuistry is formed by 2 groups of patients. The first group contains 225 malleolar fractures, hospitalized and operated, and the second group contains 87 cases after 1 year from surgery (aleatory group).

2. The initial diagnosis and the postsurgical evaluation were formulated using the radiological parameters from the standard x-rays (two incidence). For the antero-posterior incidence we used Wangermans position (internal rotation of the ankle 30°) [4], to show the inferior tibio-fibular joint, but was not correctly made in all the cases.

The radiological parameters we used were the following:

- Skinner test – the congruency of astragalus
- The value of the internal tibio-astragalian space – internal tibio-astragalian diastasis
- Inferior tibio-fibular raport – inferior tibio-peronier diastasis
- Tibio-astragalian angle
- Bimaleolo-tibial angle – the shortening of the peroneus malleolus
- Measurement of fracture displacement
- Radiological parameters of ankle arthrosis – narrowing of the articular space, underchondral osteosclerosis, malleolar osteophytosis. (Figure 1)

Figure1 - Normal radiological parameters

Results

Osteo-ligamentary lesion mechanism was evaluated through clinical and radiological examination, systematizing the first group based upon the Lauge-Hansen classification [5]. (Table I), (Figures 2 and 3), (Table II), (Figures 4 and 5), (Table III), (Figures 6 and 7), (Table IV), (Figures 8 and 9), (Table V), (Figure 10)

Table II

B. Fractures by supination-adduction		
I	Peroneus malleolus fracture, tear of anterior tibio-peronier ligament	26
II	Tibial malleolus fracture	1
Total		27

Figure 4 - Supination-adduction

Figure 5 - Bimalleolar fracture

Table III

C. Fractures by pronation-external rotation		
I	Tibial malleolus fracture or tear of deltoid ligament	7
II	Tear of anterior tibio-peronier ligament	0
III	Peroneus malleolus fracture	73
IV	Posterior marginal fracture or tear of posterior tibio-peronier ligament	23
Total		103

Figure 6 - Pronation-external rotation

Figure 7 - Bimalleolar fracture and luxation

Table IV

D. Fractures by abduction (pronation-abduction)		
I	Tibial malleolus fracture or tear of deltoid ligament	2
II	Posterior marginal fracture or tear of both tibio-peronier ligament	2
III	Peroneus malleolus fracture	33
Total		37

Figure 8 -
Pronation-
abduction Figure 9 - Peroneus malleolus fracture
with tibial equivalency, external luxation

Table V

E. Fractures by pronation-dorsiflexion		
I	Tibial malleolus fracture or tear of deltoid ligament	0
II	Anterior marginal fracture	2
III	Peroneus fracture	0
IV	Posterior marginal fracture	0
Total		2

Figure 10 - Bimaleollar and posterior marginal fracture
with posterior luxation of astragalus

After 12 months from the surgery, the results were evaluated using the same radiological parameters. The abnormal values of these parameters were clinically analyzed as late complications, which take in discussion the precision of the first diagnosis and the treatment of the lesions. (Table VI), (Figures 11, 12, 13 and 14)

Table VI

Result	No	%
Normal consolidation	45	51,7
Normal consolidation with incipient arthrosis	8	9,2
Arthrosis risk	22	25,3
Arthrosis	12	13,8

Figure 11 - Arthrosis after
bimaleolar fracture Figure 12 - Arthrosis after
bimaleolar and posterior marginal
fracture Figure 13 - Severe arthrosis after
trimalleolar fractures Figure 14 - Arthrosis after
bimaleolar fracture

Discussion

A correct evaluation of the x-rays permit not only to establish a complete lesional diagnosis, but also the evaluation of late complications with insidious clinical manifestations sometimes [6].

The radiological parameters show the continuity of articular surfaces, centration and parallelism of astragal in the ankle joint. Skinner test appreciate the congruency and decentration of astragalus, which suggest ligamentous lesions. External luxation, showed on x-rays by the internal tibio-astragalian diastasis, with tolerated value till 4 mm, signifies internal ligamentous lesions associated to the peroneus malleolus fracture, and the presence of inferior tibio-peronier diastasis (empty space 5 mm) signifies lesions of inferior tibio-peroneal ligaments [7].

In single fractures with displacement of peroneus malleolus should be suspected possible ligament damage, mentioned above, highlighted in radiological forced positions. Joint unilateral external may be following a fracture of the tibial pylon, and its association with decentred of astragalus and peroneus malleolus fracture is associated with ligament injuries. Peroneus malleolus is an element of joint stability that can be compromised by fracturing. Peroneus malleolus, measured movements based on radiological indexes, impose appropriate osteosynthesis techniques to ensure a perfect anatomical restoration and firm stability. A shortening of radiological peroneus malleolus by more than 2 mm is intolerable, leading to vicious consolidation, with arthrosis risk.

Any fracture movement of over 2 mm, in either direction, is intolerable and anatomical reduction and stabilization requires. Radiographic measurement of "clear" tibio-peroneal space ($C = 2$ mm) can give informations about the integrity of tibio-peroneal ligaments. Clear space over 5 mm expresses a ligamentary injury and joint instability. Tibio-peroneal diastasis or tibio-astragalian diastasis destabilize the joint, being arthrosic risk factors. Talus tilting on x-ray profile pictures is tolerable up to 1.5° (clinical, above this value, the indices have pathological significance).

According to the evaluation of these precise parameters, we can decide that only a surgical treatment correctly applied can achieve the anatomical and biomechanical recovery [8,9]. In the second group, there observed angle values under the normal value, after 12 bimalleolar fractures, 3 peroneus malleolus fractures with internal equivalence and 4 trimalleolar fractures, having as cause the vicious consolidation of peroneus malleolus. Internal tibio-astragalian diastasis was reported after five peroneus malleolus fractures with internal equivalence (ligamentous lesions), after 3 bimalleolar fractures and 2 trimalleolar fractures. Internal diastasis means incorrectly or incomplete resolution of internal ligamentous lesions. The presence of tibio-peroneal diastasis prove retrospectively the incorrect resolution of the ligamentous lesions in this joint, reported after 5 bimalleolar lesions, 4 peroneus malleolus fractures with internal equivalency and 2 trimalleolar fractures.

Böhler consider that any displacement of astragalus, even a small one on x-ray, can be factor of arthrosis after a few years. Kapandji said, all the lesions of the ankle impose a perfect resolution, if it is wanted the recovery of the stability and of the function [10].

The above radiological parameters indicated an anatomical recovery in 60.9% of cases, although 9.19% already presented incipient lesions of arthrosis due to postinflammatory trophic disorders. In 25.28% of cases were found the elements of arthrosis risk due to late complications, and in 13.8% of cases with unfavorable evolution presented radiological signs of decentred arthrosis.

Conclusions

Joint instability increase with the complexity of the osteoligamentous injuries and with the starting of weight bearing and walk. Biomechanical conditions of the ankle impose an anatomical recovery of the osteoligamentous stability components compromised by the trauma. The surgical treatment can realize the anatomical restoration as perfect as possible. Due to early and late postsurgical evaluation, using the radiological tibio-astragalian parameters, we can find the sequelar articular imperfections

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