

From Diagnosis to Therapy Planning:

Classifications and problem lists

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1. Introduction

Classifications – a form of refined diagnosis - are necessary and useful simplifications to group cases as a prerequisite to communication. However, classifications do not sufficiently consider that there are transitional forms of diseases and injuries which do not fit in defined classification categories. Biologic phenomena always show a continuum of transitional forms. We take the ankle region as example: involvement of the distal tibial weight-bearing surface is a characteristic of pilon fractures with important therapeutic and prognostic consequences. However, the boundaries between pilon and malleolar fractures are sometimes blurred and classifications do not address influential details of the pathologies encountered: certain malleolar fractures show an important anterior or posterior impaction zone (2,3) which requires attention and adequate treatment.

Classifications with their necessary simplifications are therefore insufficient for detailed “Therapy Planning”. Using only main classification groups and adding a **“problems inventory”** is in our hands more helpful. Problems are identified by thorough analysis of patient data, anamnesis and adequate imaging. The next step of the planning process is to create a **“solutions inventory”**. After weighing the pros and cons of the different options for a given patient, one of them can be chosen for the final planning taking also into account the surgeon’s and hospitals conditions.

2. Diagnostic and therapeutic problems

The examples (Figures 1 to 8), chosen from the ankle region of the ICUC App, illustrate the advantages of combining simple and generally accepted classification groups and a detailed “problems inventory” for the planning process. The advantages are more evident in complex and special cases (Figures 4 to 8) with comminution zones, articular impaction or mortise-stability problems. To understand relevant anatomical details and morphological variations a generous use of CTs (Figures 1 to 8) is beneficial (2).

3. Discussion and conclusions

Classifications refine the diagnosis. Supplementing a detailed problems inventory in a given case to a simple classification helps to formulate a solutions inventory. A generous use of CT – imaging and clinical examination yield details not considered by classifications but relevant for planning and therapy. Involvement of the weight bearing surface of the distal tibia is a characteristic of tibial plafond fractures but also of complex malleolar fractures. Classifications for malleolar fractures, do not take into consideration extent of anterior marginal impaction and osteochondral fragments. However, these elements are fundamental for a correct treatment. In the majority of cases conventional intra-operative X-rays and tests of mortise stability are sufficient to decide about the need of additional position screws or alternative techniques. 3D-imaging might be needed intra-operatively in special cases of notch variations to avoid invasive exposures. As always in biology there are different, equivalent options and not only a single “evangelical” one. Postoperatively it is possible to check, if the different problems of the inventory have been solved and to check the quality of the technical execution. Eventual differences between work as planned (1,3, 5) and work as done are valuable sources for learning (4).

4. Summary

A detailed pre-operative plan must be based on the precise recognition and definition of the problems inventory of a given case. A generous use of pre-operative CTs is helpful to better understand the details of a given lesion and avoid to discover them only intra-operatively. For therapy planning, adding the problems inventory to a simple group classification is more useful than insisting on classification sub-groups. Comparing work-as-planned and work-as-done is a precious source of learning.

5. Examples

The main above statements are illustrated hereinafter with a few detailed cases, followed by a list of further cases which can be found in the ICUC® app.

1. Marginal, anterior impaction and comminution zones



Fig. 1: Bi-malleolar fracture, AO Classification 44-B2. ICUC App case ID: 44-TS-673, images pictures 1 and 3 out of 241 (this is one out of 56 ankle cases that are available in the ICUC App). To correctly assess an eventual impaction of the anterior joint surface of the distal tibia, a generous use of CT is advantageous. Common classifications do not sufficiently address comminution and impaction zones, important for the choice of the treatment. To recognize these technical problems is more important than lengthy discussions about classification subtypes. In addition to the articular impaction, the medial malleolar fragment shows a comminution zone at the proximal end. A screw fixation of the medial malleolus would bear the risk of secondary vertical dislocation. Therefore a buttress plate is used ([Fig. 2](#)).

ID: 44-TS-673 / 65y

Overall Assessment: To be discussed

AO: 43-B2

< 1 Week

SURGICAL APPROACH
Lateral + Medial approach. Tibia implant: hook plate. Fibula implant: hook plate.

SUMMARY
Transient Ex. Fix. Open joint reconstruction. Bone substitute.

DISPLACEMENT: ● ● ○
COMPLEXITY: ● ● ●
REDUCTION: ● ● ○

desmotic Tibial Pilon **Transsyndesmotic** Infrasyndesmotic Suprasyn

Fig. 2: Overview of bi-malleolar fracture of Fig. 1: AO Classification: 44-B2. What does it help to decide whether it is a B.2.2. or a B.2.3 sub-type? The fracture type on the fibula is less important than the impaction of the articular surface of the tibia. Defining a “problem inventory” is more helpful to choose the treatment: horizontal fibula fracture, important anterior impaction (Fig. 1) of the tibia and vertical fracture of medial malleolus with comminution zone proximally. After reduction of the anterior impaction, cancellous bone, allograft or bone substitute is needed for buttressing. A buttress plate is needed for the medial malleolus to avoid secondary dislocation (it is clearly a case for an experienced surgeon).

ID: 44-TS-538 / 40y

Overall Assessment: To be discussed



AO: 44-B2

< 1 Week

Open

SURGICAL APPROACH

Medial + lateral approach. Tibia implant: lag screw. Fibula implant: plate. Ex Fix.

SUMMARY

Lateral articular instability after screw fixation on the medial side and plate fixation on the lateral side. This leads to additional Ex Fix. for 3 w.

DISPLACEMENT



COMPLEXITY



REDUCTION



desmotic Tibial Pilon Transsyndesmotic Infrasyndesmotic Suprasyn

Fig. 3: Fracture with an X-ray similar to previous case (bi-malleolar fracture AO Classification: 44-B2) but is a different clinical problem (ICUC App case ID: 44-TS-538, out of 56 ankle cases). The fracture - at first glance - is similar to the fracture of Fig.1 and 2: More important than the sub-classification B2.2, or B.2.3 is the fact that there is neither a comminution at the proximal end of vertical fracture of the medial malleolus nor a relevant impaction of the joint line. A screw fixation medially is sufficient. The anterior tibia is not severely injured and no treatment is needed. However - despite the anatomical reduction of the malleoli - because of the evident ligamentous instability (see images 148, 149, 153 out of 157 of this case) an Ex.Fix. was chosen to hold the talus anatomically within the mortise.

2. Volkmann, Le Fort and Chaput Fragments

CT is a prerequisite for understanding details of complex ankle fractures (Figures 4 to 6).

ICUC® App / Reference Cases / Posterolateral | ICUC ID: 44-TS-740



Fig. 4: Volkmann Fragment with interposition of osteochondral fragment (details ICUC App case ID: 44-TS-740 out of 56 ankle cases and pictures 3, 104, 219 out of 399 of this case). CT to understand details of the fracture. Removal of rotated little fragment to allow anatomic reduction of the Volkmann is shown. Result: plate fixation through posterior approach (right image) To specify the different elements of the lesions in the problems inventory contributes significantly to existing main group classifications. Impaction and osteochondral fragments are not enough considered in the classification subgroups. A summary of this case can also be found in the ICUC® App under *Ankle / Reference Cases / Posterolateral*

ID: 44-TS-328

ID: 44-TS-328 / 55y

Overall Assessment: Recommended



AO: 44-B3

< 1 Week

Broken Syndesmosis

SURGICAL APPROACH

Medial + lateral approach. Tibia implant: tension band. Fibula implant: antiglide plate. Suprasyndesmotom screw.

SUMMARY

Complex tri-malleolar fracture. CT mandatory. Posterolateral Volkmann, Le Fort fragment, syndesmosis intact. Therefore, no need for position screw.

DISPLACEMENT



COMPLEXITY



REDUCTION



desmotic Tibial Pilon Transsyndesmotom Infrasyndesmotom Suprasyn

Fig. 5: Le Fort fragment in a malleolar fracture AO Classification: 44-B3 (ICUC App case ID: 44-TS-328). Details of the lesion are not well understood in the conventional X-ray (left upper image), CT adds essential information (right upper image). The statement "Tri-malleolar fracture with displaced Le Fort fragment" is more meaningful than the classification B.3.3 indicating a multi-fragmentation of the fibula. ORIF with tension band on the medial side and antiglide plate on the lateral side.

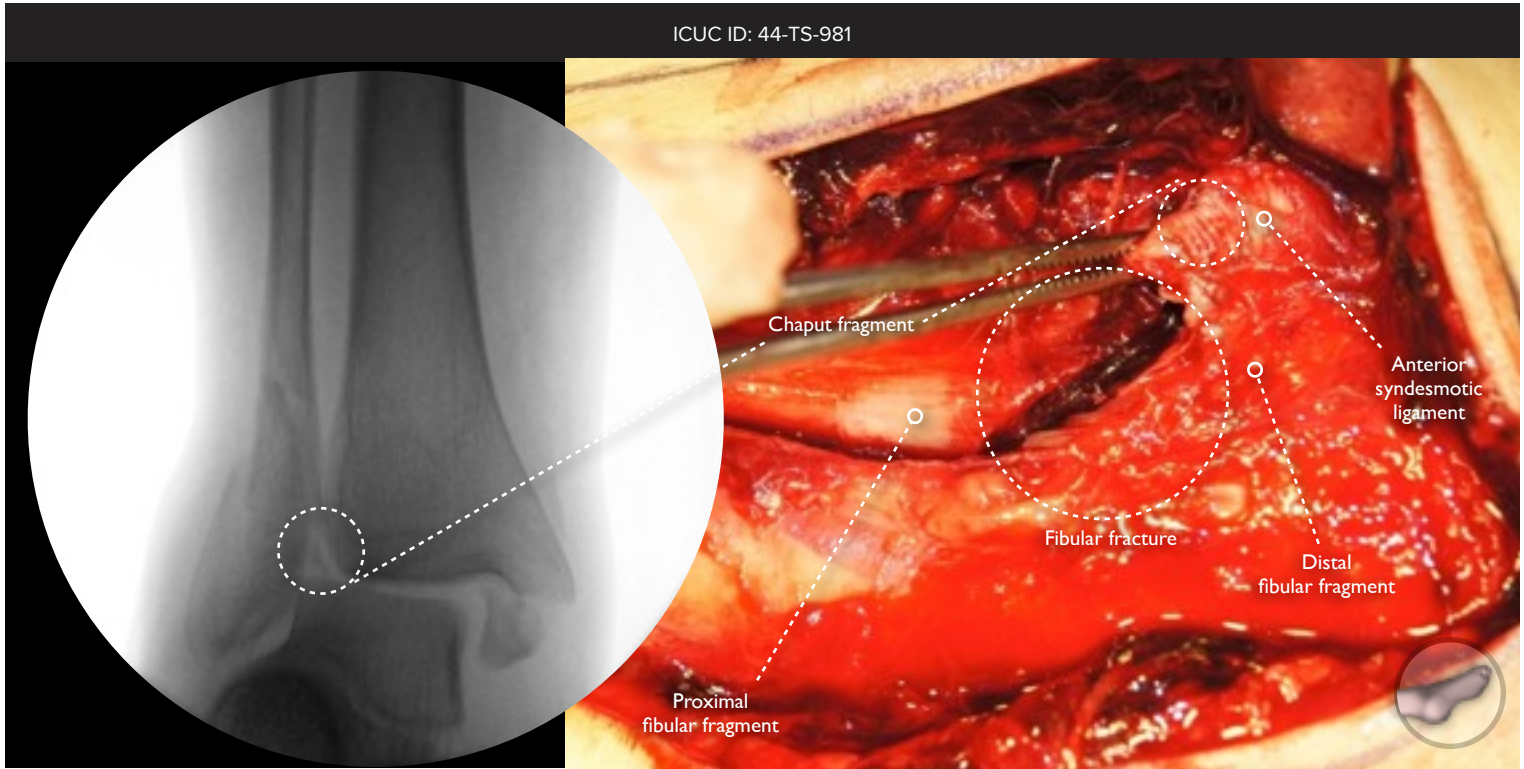


Fig. 6: Tri-malleolar fracture, AO 44-B3 with Chaput fragment (ICUC App case ID 44-TS-981, images 7 and 164 out of 181 of this case). The so-called “Chaput fragment or tubercle” – sometimes called the 4th malleolus – is rarely displaced. If avulsed, reduction and fixation is required to restore articular congruity and ankle stability. A pre-operative CT avoids intra-operative surprise.

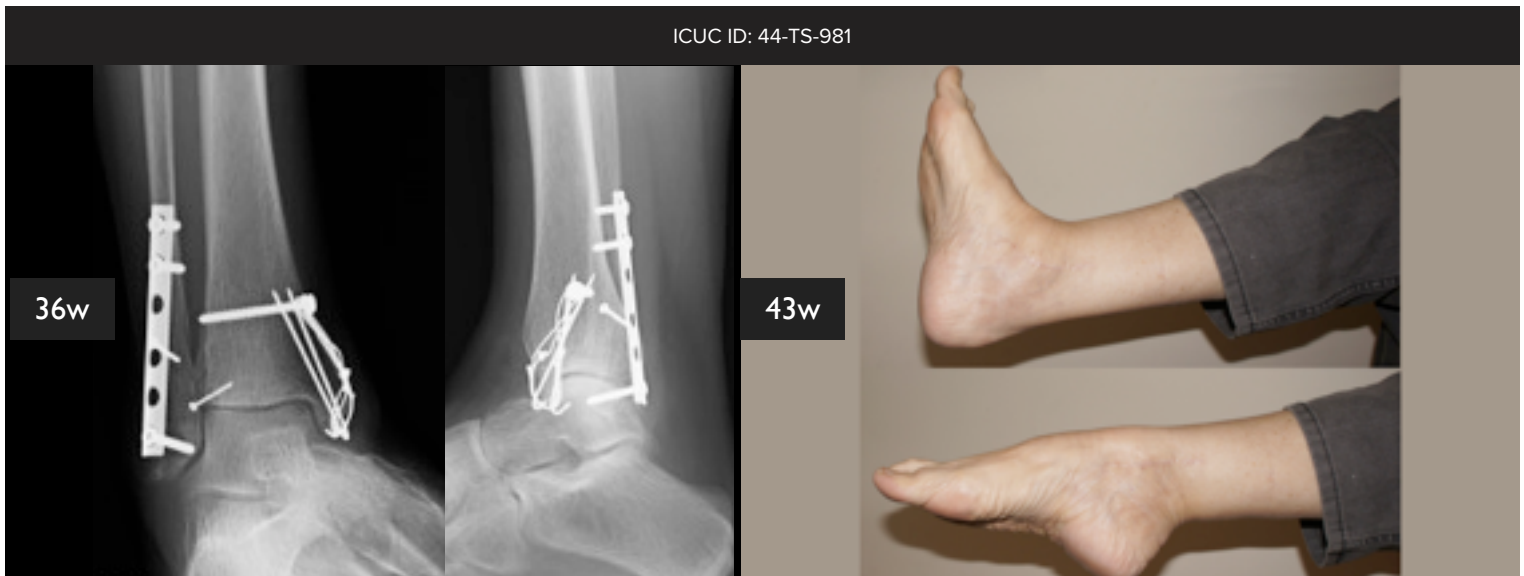


Fig. 7: The Chaput fragment is reduced and fixated with a mini-screw. Radiological and clinical result after 36 and 43 weeks (ICUC App case ID: 44-TS-981, images 161 and 162 out of 188 of this case)



Fig. 8: Supra-syndesmotic malleolar fracture, AO type C.2 with dislocated Chaput fragment (ICUC App case ID: 44-SS-272, images 1 and 2 out of 112 of this case). The conventional image does not allow a complete diagnosis. CT shows that Chaput fragment in the right image is larger than the one shown in the previous figures (and more dislocated than expected in the conventional X-ray) (Z).

6. List of other malleolar cases from the ICUC App

Illustrating the above statements about classification, problem inventory and imaging:



ICUC ID 44-TS-449
Tibia shaft fracture with associated
Malleolar fracture



ICUC ID 44-SS-417
Fracture dislocation,
osteochondral fragment



ICUC ID 44-SS-485
Maisonneuve fracture



ICUC ID 44-SS-212
Mortise stability, mortice view
and syndesmosis position screw



ICUC ID 44-SS-212
Hook test



ICUC ID 44-TS-955
Value of post-operative imaging

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