Original Article

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Classification of Distal Femur Fractures and Their Clinical Relevance

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Abstract

Introduction: Analysis and classifying distal femur fractures is one of the important steps for an orthopaedic surgeon towards a successful outcome in treating these fractures. Few surgeons tried to classify these fractures and we discuss in detail those systems and their clinical relevance . Three classification systems have been discussed below and it has shown the Müller AO classification system remains the ideal classification for these fractures as it is user friendly, easy to document and gives an idea on the prognosis .

Keywords : Distal femur fracture, classification, Müller, AO, Hoffa.

Introduction

To treat a fracture better, we need to understand it better. To understand them better, we need to analyse them better and classify them . Distal femur fractures are often comminuted and intra-articular, and they frequently involve osteoporotic bone, which makes it difficult to reduce them while maintaining joint function and overall limb alignment [1,2]. Hence, classifying them in an appropriate manner which would help surgeons to give a better outcome is of utmost impotance. Unlike proximal femur fractures – which have numerous classifications to describe them – there are only a few systems proposed for distal femur fractures mainly due to the less complex muscular anatomy and vascular anatomy involved between both these regions[3,4,5].

For a classification system to have clinical significance, it must be able to :

1) allow adequate documentation so that a common language is possible to discuss these injuries

2) be 'user friendly'

3) help in clinical decision making

4) prognosticate the outcome depending on the treatment option [3] .

We shall discuss about the various classification systems described for distal femur fractures and their clinical significance .

Classification of distal femur fractures and their clinical relevance

Classification systems in distal femur fractures :

The various classification systems described for distal femur fractures are :

1) Neer and associates (1967)

2) Seinsheimer classification (1980)

3) AO Classification - Müller (1990)

Neer and associates classification [8] :

One of the simpler classification systems of supracondylar femur fractures was that of Neer and associateswhich was described early in 1967 . They subdivided supracondylar- intracondylar femur fractures into three primary categories . The 2nd category had two subdivisions[8] .

Category I : Minimal displacement

Category II : Displacement of the condyles

A) Medial condyle displacement

B) Lateral condyle displacement

Category III : Concomitant supracondylar and shaft fractures [Fig 1]

Clinical relevance :

This classification was very basic and did not give much clinical information to the surgeon . No light was thrown upon coronal plane fractures . Moreover , there was no information on the prognosis of these injuries[3]. Hence, this system did not gain much popularity and is seldom used anywhere now among trauma surgeons worldwide .

Seinsheimer classification [9] :

In 1980, Seinsheimer published his system where he classified the fractures of the distal 3.5 inches of the femur into 4 types [9].

Type I : Non-displaced fractures (less than 2mm displacement)

Type II : Distal metaphyseal fractures (Extra-articular)

II-A : 2 part fractures

II-B : Communited fractures

Type III : Fractures involving the intercondylar notch in which one or both condyles are separate fragments

Type IV : Intra-articular fractures

IV-A : Medial condyle fracture

IV-B : Lateral condyle fracture

IV-C : Comminuted fractures

Clinical relevance :

Seinsheimer found that the type I and II fracture patients had osteoporosis prior to the injury and they were usually following low energy trauma . On the other end of the spectrum , he found that type IV fractures resulted from high energy trauma[9]. This classification system though it had a better descriptive detail about the fracture pattern , did not become popular as it was not user friendly and provided minimal information on prognosis[3].

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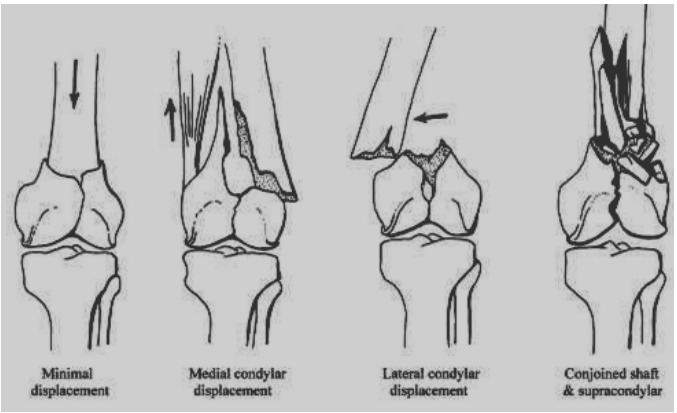

Figure 1: Neer and associates classification

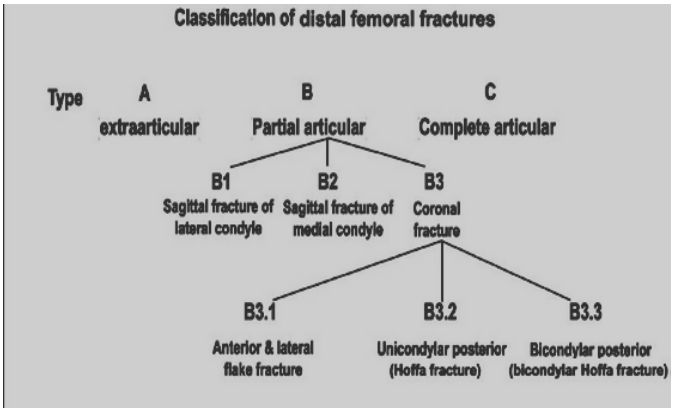

Table 1: Basic algorithm – Distal femur fracture classification – Müller AO :

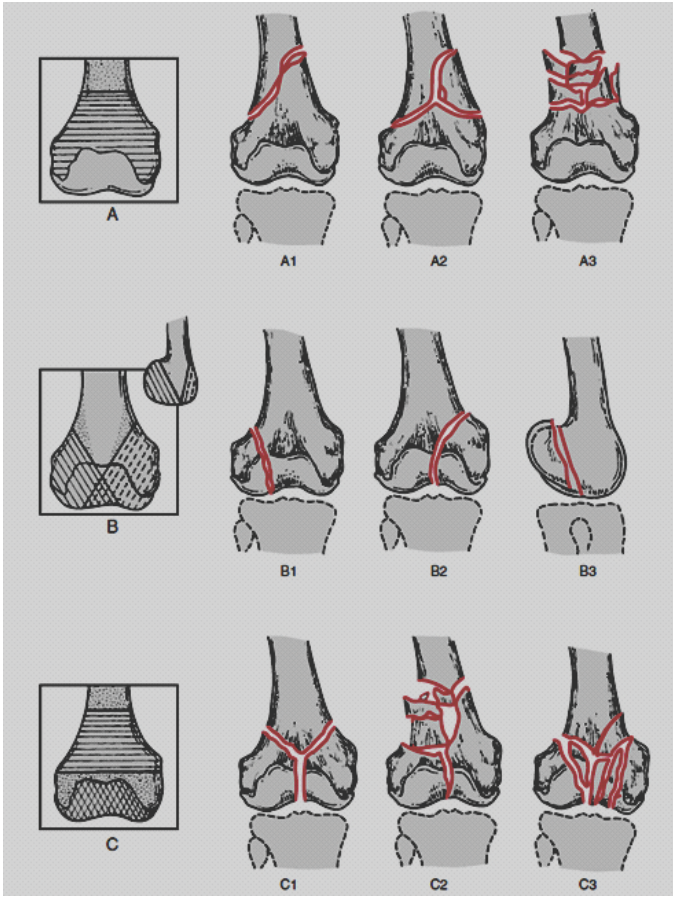

Figure 2: The Müller Classification

Classification System	Year it was Proposed	Clinical Significance
Neer and associates	**1967**	*- Very basic*
		- No information on coronal fractures and prognosis
		- Not used nowadays
Shensheimer	**1980**	*- More detalied than Neer's system*
		- Based on osteoporosis and trauma velocity
		- Not user friendly and difficult to use in data documentaion and communication among surgeons
		- Seldom used
Müller Classification (AO Group)	**1990**	*- Detailed classification based on the anatomical relation with the articular surface of the distal femur*
		- Coronal fractures classified in detail
		- Gives a good idea bout prognosis of these injuries
		- Accepted unnanimously and has become the standard classification for distal femur fractures worldwide

Table 2: Summary of Classification systems for distal femur fractures and their signifance :

Fracture type (Based on Müller AO Classification for distal femur fractures)	Recommended Treatment option
Type A	MIPO (Minimally invasive plate osteosynthesis) or Retrograde nailing
Type B	Open reduction and fixation with Lag screw / Antiglide plate if fracture extends above
Type C	Open reduction followed by reconstruction of articular surface and stabilisation with a Locking plate
Type B3 (Hoffa's fracture)	Open reduction and fixation with a Lag screw (Herbert screws can be used for articular reconstruction)
Type C3	Joint spanning fixator may be used as a salvage procedure or could be used till the soft tissue condition improves after which an Internal fixation can be done

Table 3: The recommended Surgical treatment option based upon the type of the Muller's classification is[12,13]

AO Classification system - Müller and associates [6,7,80] :

The "Schweizer Arbitsgemenischaft fur Oseosysthesesfragen" Group (SWISS AO) , chaired by Müller, through its documentation data centre in Davos brought forward their classification system on distal femur fractures after analysing thousands of these fractures . This system has been found to be easy to use and satisfies all the criteria for an ideal classification [3,8] .

Müller and his colleagues divided these fractures into 3 primary groups [6,8] . Based on the common principles of the AO classification, type A fractures include extra-articular fractures and type B fractures are partial articular fractures, meaning parts of the articular surface remains in contact with the diaphysis of the femur [Fig 2]. Type C fractures include complete articular fractures with both condyles being detached from the diaphysis. The fracture types are further subdivided describing the degree of comminution and other characteristics. Further subdivision of type B fractures includes Bl (sagittal, lateral condyle), B2 (sagittal, medial condyle) and B3 (frontal, Hoffa type). Fracture type C is divided in C1 (articular simple, metaphyseal simple), C2 (articular simple, metaphyseal multifragmentary) and C3 (multifragmentary)[8].

The B3 type fracture – popularly known as 'Hoffa's fracture'- has immense clinical signifcance in the outcome following treatment and has been further subdivided into three types [3,8,10] . This type of cornoal fractures of he distal femur are further classified into :

B3.1 – Anterior and lateral flake fracture
B3.2 – Unicondylar Hoffa's fracture
B3.3 – Bicondylar Hoffa's fracture

Clinical relevance :

This classification also states that progressing from type A to type C , the severity of the trauma and injury increases whereas the prognosis for a good outcome decreases [3,10,14] . This relation also holds true for the progression from type 1 to type 3 in each group . Communication among surgeons worldwide regarding distal fractures using this system was easy and it was unanimously accepted as the gold standard classification woldwide [3,9]. Regarding the appropriate treatment or surgical option for any particular type of fracture based on the AO Müller classification system , there have been many articles published[11-16] . The final treatment for the patient anyhow needs to be taken by the treating surgeon depending upon many factors including the soft tissue status and the general condition of the patient [16]. A variety of surgical exposures, reduction techniques and various new implants have been developed to treat such fractures and these include intramedullary nailing, screw fixation ,periarticular locked plating and also the LISS (Less Invasive Stabilization System) technique [15,16] . However, in simple fractures compression osteosynthesis should be favoured over bridging osteosynthesis since higher rates of non-unions have been reported for using locking plating for treatment of simple fractures[12].

Conclusion :

Among all the classifications described for distal femur fractures, the Müller AO classification system is the most widely accepted system and is being used worldwide. This classification takes into account the involvement of anatomic region of the distal femur, the energy of the injury and also prognosticates the outcome . It has a high inter-observer reliability and validity. Being user friendly and also serving as a common language among surgeons worldwide to discuss distal femur fractures, this classification is the one of choice for treating these fractures.

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