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New Comprehensive Classification Systems for Peri-trochanteric Femur Fractures

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Abstract

Purpose: A classification is considered as good classification if it describes the particularregion of bone, type of fracture, personality of fracture in either planes and helps in selectionof implant and most importantly easy to understand by an orthopedic surgeon. Classification becomes more complicated when there is double region involvement with comminution,or distal fracture is in shaft leading to segmental fracture.

Materials and Methods: There are numerous classification systems available in the presentliterature for peri-trochanteric femur fractures. These include Evan's, Tronzo, and Boyd andGriffin, OTA classifications for peri-trochanteric region, Seinsheimer's and Fieldingclassifications for sub-trochanteric region. AO classification which is widely acceptedcritically defines peri-trochanteric, head and neck region of fracture femur.

Results: Drawbacks of existing classifications are that they are based on fractureconfiguration in sagittal plane only except Seinsheimer's classification which is based oncoronal plane fracture morphology. Furthermore, double regions/ multiple regions arenot properly defined in these classification systems. If the proper classification system is not followed, it will lead to the selection of wrong implants which thereby leads to complications.

Discussion: Advantages of our new classification system are that it is easy to understand; allregions of peri-trochanteric femur are covered, and in the selection of proper implant.Hence, intra-operative complications can be avoided with proper pre-operative planning.

Conclusion: Thus, we hope that our new comprehensive classification of peri-trochantericfemur may help to solve the mysteries surrounding the understanding, classifying, and treating the fractures of peri-trochanteric femur.

Key words: Classification, comprehensive, femur, fracture, peri-trochanteric.

Introduction

The proximal femur is divided into head, neck, trochanteric area, isthmus (narrowest regionof shaft of the femur), and the diaphysis with condyles distally. When the in- duty houseofficers were preparing the thesis on the management of peri-trochanteric femur fractures as apart of the requirement in the post graduate curriculum for orthopedics, we found that somefractures of peri-trochanteric femur fractures that involve double region, or bifocal femur fractures were not classified in any of the conventional classification systems available in theliterature. Furthermore, the incidence of multi-fragmentary bony injuries and complextrauma of peri-trochanteric region of the femur is on rise. As we deal with a huge numberof trauma patients in our hospital, we have examples of the entire unclassified complexperi-trochanteric femoral fractures from our in-hospital registry. Complex fractures aredifficult to understand unless three-dimensional computed tomography scan is donewhich may not be cost- effective in all the centres worldwide.

Materials and Methods

The research for all the classification systems of peri-trochanteric femur was done in literatureavailable through online search engines on EBSCO, MEDLINE, PUBMED, and OVID whichincluded all indexed international journals. We found the conventional classification systemthat includes Evan's, Tronzo, and Boyd's and Griffin, OTA classifications forperi-trochanteric region, Seinsheimer'sand Fielding classifications for sub-trochanteric region. Details of the pre-existing classification systems include the following:

A. Boyd and Griffin classification (1949 A.D) [1]:

It includes all fractures in the extra-capsular part of the neck to a 0.5 cm distal tolesser trochanter.

Type I: Fractures that extend along the intertrochanteric line from greater to lessertrochanter.

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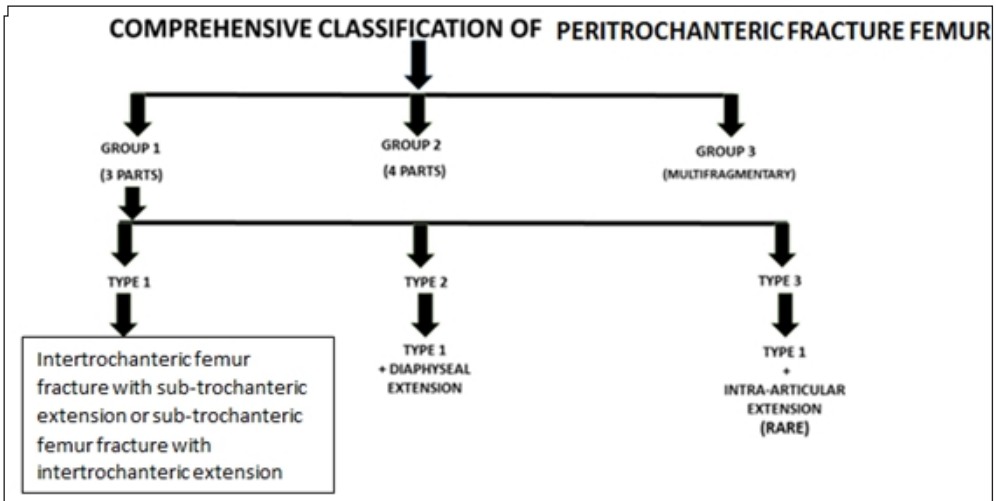

Figure 1: New comprehensive classification system for proximal femur fractures. The classification includes 3 groups (Group 1, Group 2 and Group 3). Group 1 includes 3 parts fracture of peritrochanteric region of femur, Group 2 includes 4 parts fracture of peritrochanteric region of femur and Group 3 includes multifragmentary fracture of peritrochanteric region of femur. Subdivision of all three Groups is done into three types (type 1, type 2 and type 3). Type 1 includes intertrochanteric femur fracture having sub trochanteric extension and sub trochanteric femur fracture having inter trochanteric extension. Type 2 includes inter trochanteric fracture femur with diaphyseal extension. Type 3 includes inter trochanteric fracture femur with intra articular extension (rare type and includes fracture neck femur with inter-trochanteric femur fracture)

Type II: Comminuted fractures, main fracture being along the intertrochanteric linebut with multiple fractures in the cortex.
Type III: Sub trochanteric fractures with at least one fracture passing along the proximal end of the shaft just distal to or at lesser trochanter.
Type IV: Fractures of trochanteric region and proximal shaft with fractures in two planes.
B. Evan's classification (1949 A.D.) [2]:
Type I: Fracture line extends upward and outward from lesser trochanter. It is subdivided into:
Stable: 1. Undisplaced.
2. Displaced but reduced.
Unstable: 1. Displaced but not reduced.
2. Comminuted.
Type II: Obliquity of major fracture line is reversed; major fracture line extends outward and downward from lesser trochanter.
C. Tronzo classification (1973 A.D.) [3]:
Type I: Incomplete trochanteric fractures
TypeII: Uncomminuted trochanteric fracture with or without displacement in which both trochanters are fractured.
Type III: Comminuted fractures with large lesser trochanteric fragment and posterior wall exploded with the beak of inferior neck already displaced into medullary cavity.
Variant: Greater trochanter is also fractured and separated.
Type IV: Comminuted fracture with disengagement of two main fragments with spike of neck fragment outside shaft.
Type V: Reverse obliquity of fracture line.
D. Jenson and Michealson modification of Evan's classification (1980 A.D.)
[4]:
TypeI: Un-displaced two-fragment fracture
Type II: Displacedtwo-fragment fracture
Type III: Three- fragment fracture without postero-lateral support, owing to displacement of greater trochanter fragment.
Type IV: Three- fragment fracture without medial support, owing to displaced lesser trochanter or femoral arch fragment.
Type V: Four-fragment fracture without posteromedial and lateral support (combination of Type III and Type IV)
Type R: Reverse obliquity of fracture line.
E. The A.O classification (1996 A.D.) [5]:
A1. Peri-trochanteric simple:
A1.1. Along intertrochanteric line (Cervicotrochanteric)
A1.2. Through greater trochanter (peri-trochanteric)
A1.3. More than two intermediate fragments
A2. Peri-trochanteric multi-fragmented
A2.1. One intermediate fragment
A2.2. Two intermediate fragments
A2.3. More than two intermediate fragments.
A3. Intertrochanteric
A3.1. Reversed simple
A3.2. Transverse simple
A3.3. Additional fracture of medial cortex.

Results

In Boyd and Griffin classification system, it is difficult to classify fractures sometimesbecause it fails to account for fracture pattern, which does not fall into any of the four types.This classification does not mention anything about the fractures whether these are displaced or un-displaced. In Tronzo classification system, it is difficult to classify fractures sometimesbecause of fracture patterns, which may be fitting into more than one type and therefore highinter-observer and intra-observer variation creeps in. Drawbacks of all existing classificationsare that the previous authors have given classifications based on fracture configuration in thesagittal plane except Seinsheimer's classification which is based on coronal plane fracturemorphology. Double or bifocal regions/ multiple regions are not properly defined in these classification systems. Selection of implants cannot be determined based on these classification systems. Among all the existing classification systems, we have found the A.O.classification with low inter-observer as well as intra-observer variations. AO classification which is widely accepted critically defines peri-trochanteric, head andneck regions of fracture femur; however, they have not included double region combinations of fractures orbifocal femur fractures. Drawbacks of existing classifications are that they are based onfracture configuration in sagittal plane only except Seinsheimer's classification which is based

R_`jc /8 Rfc rf pcc epns nq* rwncq* _l b rf c qcjcargnl nd the implants accordingly	
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Rwnc GG	? DL-NDL GG
Rwnc GGG	NDNj_rc
Epns n 0	
Rype I	BFQ
Rwnc GG	? DL-NDL GG
Rwnc GGG	NDNj_rc
Epns n 1	
Rwnc G	BFQ
Rwnc GG	? DL-NDL GG
Rwnc GGG	NDNj_rc
BFQ8 Bwl_k ga f gn qapcu * ? DL8 ? l rcep_bcdck sp l_gjgl e* PFN: Proximal femur nailing, PF Plate: Proximal femoral plate	

on coronal plane fracture morphology. The new comprehensive classification of peri-trochanteric fracture femur classifies the fracture into three groups. Basically, Group 1 includes three parts peri-trochanteric femur fractures, Group 2 includes four parts peri-trochanteric femur fractures, and Group 3 includes peri-trochanteric femur fractures with more than four parts (multi fragmentary). These three groups are further classified into three types (Type 1, Type 2, and Type 3).Type 1 peri-trochanteric femur fracture includes intertrochanteric femur fracture with subtrochanteric extension and/or sub trochanteric femur fracture with intertrochanteric extension.Type 2 peri-trochanteric femur fracture includes intertrochanteric femur fracture with diaphyseal extension. Type 3 includes intertrochanteric femur fractures with intra capsularextension (which includes femur neck and head fractures).
Another simple and short classification system proposed by us is the following:
Peri-trochanteric femur fracture to be classified mainly into two parts:
1. Stable without comminution
2. Unstable with comminution:
2a. Unstable with medial pillar disruption
2b. Unstable with lateral pillar disruption (reverse I/T with sub-trochanteric extension)
2c. Both pillar disruption
2d. Segmental fracture.

Selection of implants

Selection of proper implants is very important for better functional and clinical results. Stableand unstable fractures can be treated with sliding hip screw and intra medullary nailing,respectively. Table 1 serves as a suggestive guideline for implant selection.

Discussion

Fractures of proximal femur are very common worldwide. Although femur neck fractures commonly occur in geriatric population mainly due to trivial falls, inter-trochanteric and peri-trochanteric femur fractures occur in young adults and middle age group populationmainly due to high- velocity trauma. Fractures of the peri-trochanteric femur are more thanever, an important challenge in the field of traumatology [6]. These fractures are one of the most common fractures occurring in the hip in the elderly as emphasized by Smith Peterson"Human beings come in this world through the pelvis and leave this world through brokenhips." In this 21st century, the focus has shifted from anatomical fixation to biologicalfixation of all fractures [7]. Girdlestone had warned "there is inherent danger in themechanical efficiency of our modern methods, danger lest the craftsmen forget that unioncannot be imposed but may have to be encouraged. Where bone is a plant, with its roots insoft tissues and when its vascular connections are damaged, it often requires, not thetechnique of a cabinet maker, but the patient care and understanding of a gardener." The goal is to obtain the union of fracture in the most anatomical position compatible with themaximal functional return of the extremity as early as possible [8]. Because it is impossible tointervene surgically without adding further injury to the extremity, the technique chosenshould minimize additional soft tissue damage and bone injury. An anatomical reductionobtained at the expense of total devascularization of the fracture is not a well-planned orwell-executed procedure [9]. One must always remember that any form of fixation is at best a splinting device with a definite life span and there is always a race between fracture unionand failure of implant. In the current century, due to increased life expectancy and increasedexpectancy of a better quality of life, the orthopedic surgeons have a great challenge to facein treating peri-trochanteric femoral fractures [10]. The surgical management of thesefractures has gone through an array of implants and surgeries. Many questions have been raised regarding the configuration of a perfect fixation device. Until recently, most of thesefractures were treated by a sliding hip screw system. Since this device performed less well inunstable peri-trochanteric femoral fractures with high rates of failure, intramedullary fixationdevices using minimal invasive fracture fixation technique have become increasingly popular[11]. A skilled surgeon can treat these fractures with any type of fixation device as long as heremembers that the fixation device will never make up for surgical failures. Therefore, improvement in the treatment of peri-trochanteric femoral fractures will be predominantly inthe hands of surgeons, rather than those of the implant industry [12]. "All clinical activity isit assessment or treatment, investigation, and evaluation or learning and teaching must bebased on sound database which can be properly assembled, clearly expressed, and readilyassessable:" W. M. Murphy.A classification is considered as good classification which defines region of the involvedbone, type of its fracture, personality of fracture in either plane and helps in selection of proper implant. It should be easy to understand for an orthopedic surgeon to communicatewith other surgeons on pre-operative planning regarding patient and fracture management. Atthe same time, it should give some clue for the prognosis following treatment. Classification of peri-trochanteric fracture femur becomes more complicated when there is a double regionor bifocal involvement, fractures which are multi fragmentary with comminution or the fracture line is extending to the shaft leading to segmental fractures.

The classification isalways more reliable when the inter observer interpretation is same amongst all orthopedicsurgeons, which then leads to better fracture evaluation, pre-operative planning, and proper post-operative management with rehabilitation.The classification overall dictates very well the easy understanding for the descriptionrequired to define fractures of peri-trochanteric femur involving more than one region. Itshould thus be helpful for better understanding the personality of the fracture, for betterdiscussion during trauma rounds and clinical meetings for better selection of the implants, leading to successful patient- related outcome measures. The goal of any classification is to group fracture patterns with regards to proper treatment and prognosis. [13,14].Advantages of both the new comprehensive classification systems as suggested forperi-trochanteric fracture femur are the following:

1. It is easy to understand
2. All regions (intra capsular extension, diaphyseal extension, and sub trochanteric extension, bifocal, and multi fragmentary fractures) of proximal femur are covered
3. Helps in selection of proper implant
4. Intra-operative complications can be avoided with proper pre-operative planning.

If the selection of implants is improper, it may lead to disastrous complications. This includes hardware failure, screws back out, infection with protruding implants, coxavara, and painful hip requiring revision surgeries which then ultimately cause increase in patient morbidity and mortality. The limitation of this study is that the clinical data to conclude that given treatment guidelines will improve the outcome is yet to be generated.

Conclusion

An intelligent surgeon may use the same implant for all fracture configurations. A wise surgeon can use different implants depending on personality of the fractures. We hope that the new comprehensive classification of peritrochanteric femur may help to solve the mysteries surrounding the understanding, classifying, and treating the fractures of peri-trochanteric femur.

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