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Research Article

Aseptic Humeral Shaft Non-union Predisposing Factor and Evaluation Treatment

Dembélé B*, Coulibaly NF, Sarr L, Gueye AB, Diouf AB, Sané AD and Diémé CB

Service d'Orthopédie Traumatologie CHU Le DANTEC, Dakar Sénégal

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***Corresponding author**

Dr Badara Dembélé, Service d'Orthopédie-Traumatologie C.H.U. Le DANTEC, Dakar Sénégal, B.P: 5994 Dakar, Tel: 00(221)775418514
Fax: 00(221)338342107;
Email: badaradembele81@gmail.com

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Abstract

Aim: To identify the main factors favoring the occurrence of aseptic pseudarthrosis of the humeral shaft Evaluate the reliability of our care.

Patients and Method: This was a continuous retrospective study over a period of 4 years and 6 months, with two Components: etiological factors (out of 22 cases) and evaluation of treatment (out of 22 cases). The mean age was 52.7 years with a male predominance (14 men and 08 women). The etiologies of the initial trauma dominated by traffic accidents. The trait was simple medio-diaphyseal in most cases with surgical treatment in 61.1% of cases. There were 15 cases of eutrophic pseudarthrosis, 2 cases of hypertrophic and 5 cases of atrophic. The management of these pseudarthrosis was surgical by decortication type Judet, re-permeabilization and osteosynthesis with inter-fragmentary compression by wide screwed plate in the 18 cases. There were 17 cases of corticospongy graft and 5 cases of shortening.

Results: Based on the criteria of STEWART and HUNDLEY, we had 16 very good results, 3 good results, 2 average results and 1 bad result. Six radial nerve lesions were observed, 4 of which were regressive.

Discussion and Conclusion: Pseudarthrosis of the humerus is a non-negligible complication of the fractures of the diaphysis whose main cause is an initial defective management. Our technique is a very effective method with the possibility of nervous complications usually transient.

Introduction

Non-union is the most common progressive and late complication of fractures of the humeral shaft. It complicates 10% of these fractures whatever the technique used and comes in 4th position after that of the leg, femur and forearm [4,15,18]. Despite this low incidence, it remains a particularly difficult complication whose treatment is difficult and varied with sometimes aleatory results.

Its management must meet rigorous techniques to avoid the many failures often reported in the literature [1,2,3,4].

The aim of this work was to determine the etiological factors of the non-union encountered in our department and to evaluate our management.

Patients and Methods

Patients

It was a prospective and continuous study from January 2008 to July 2015. All patients with non-union of the humerus were included.

Criteria for non-inclusion concerned septic non-union, patients lost to follow-up and incomplete records. The data were collected on the history of the patients (which included the patient's civil status, history and habit, initial treatment), clinical examination, radiography status, treatment and progression after treatment.

Thus 22 cases of non-union of the humeral diaphysis were collected in 22 patients. They were 14 men and 8 women with an average age of 52.7 years (23-85 years).

The reason for the consultation was the deformation of the arm during the execution of the gestures and the absolute functional impotence of the limb. All patients were right-handed and the dominant side was reached 7 times. Pain was present in 7 of them.Patients were in various occupations (6 housewives, 2 drivers, 5 without profession, 2 retired patients, 1 plumber, 1 pompist, 2 merchants, 1 fisherman, 1 receptionist and 1 transporter).

According to the radiological aspect we have found several anatopathological forms. The classification of Weber and Cech [6] allowed us to find 15 eutrophic, 5 atrophic and 2 hypertrophic forms.

Figure 1 : Number of screws per synthesis.

Surgical technique

The antero external way was used in all our patients. After dissection and isolation of the radial nerve on the string we carried out an osteomuscular decortication according to Judet followed by permeabilization of the medullary canal, curettage, and hew again the bone banks until bleeding.

The osteosynthesis used a wide AO plate in 18 cases and a narrow plate of Lecestre® type in 4 cases. The cortical intake on both sides of the non-union focus is summarized in (Figure 1).

Cortico-spongy grafting was performed in 17 patients. For all, the closure was done on a drain of Redon® aspirator which was removed on D2 postoperative. A plaster brachio-ante-brachial splint was set up for 2 months in 14 of them.

The average duration of hospital stay was 5 days (extremes 2 and 7 days). The rehabilitation process was undertaken during the hospital stay by the mobilization of the fingers in all and of the elbow in the non immobilized patients. It was active and passive when the splint was removed. Secondarily, it was actively assisted and then active. The evaluation was based on the criteria of Stewart and Hundley [11,16] for pain, mobility and quality of consolidation. The analysis of the data was carried out on EPI info software and the results are significant if p<0,001.

Results

Etiological Factors

The mean age of the patients was 52.7 years with extremes of 23 years and 85 years.

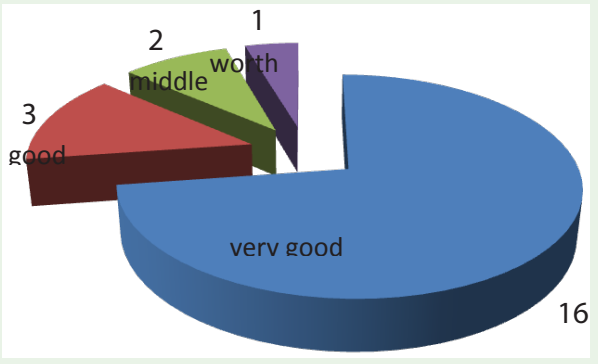

Figure 2: Evaluation of the treatment of humeral shaft pseudarthrosis.

Table 1: Distribution of pseudarthroses according to the initial treatment.

Initial Treatment	PSD hyper	PSD eutro	PSD oligo	Total
Orthopedic		4		4
Traditional		2	2	4
Surgical				14
Pins	2	5	1	8
Plate		4	2	6
Total	2	15	5	22

PSD = Pseudarthrosis; hyper = Hypertrophic; oligo = Oligotrophiceutro; Eutro = Eutrophic

The circumstances of occurrence of the initial fracture were various with a greater incidence of road traffic accidents in 15 cases, work in 2 cases, domestic accidents in 3 cases, particular accidents and public roads 1 case each (Figure 2).

Two of our patients were fat and none were smokers or alcohol addicts.

The initial fracture was closed in 21 cases and opened in 1 case; the gravity having not been specified. Radial nerve damage prior to surgery was found in 2 patients. According to the OA classification [28], the humeral shaft fractures were the most listed (18 cases): cross-sectional (11 cases) and oblique (7 cases) fractures; followed by distal third humeral fractures (4 cases). The initial treatment was surgical in 14 patients, orthopedic in 4 others and traditional for the remaining 4. In patients treated with intramedullary fixation/nailing, diastasis greater than 3mm was observed in all patients. Two pins of variable diameter (22 / 10th and 25 / 10th) have been installed in all. For patients treated with screwed plates, the latter was narrow in 2 of the cases and wide in 4 of the cases. The average number of screws was 5 per patient (extremes 3 and 8) (Figure 3).

Depending on the nature of the initial treatment instituted, the types of non-union are summarized in Table 1.

Two of the patients were already undergoing a non-union of the humeral shaft and showed a dismantling of the osteosynthesis equipment with persistence of the non-union.

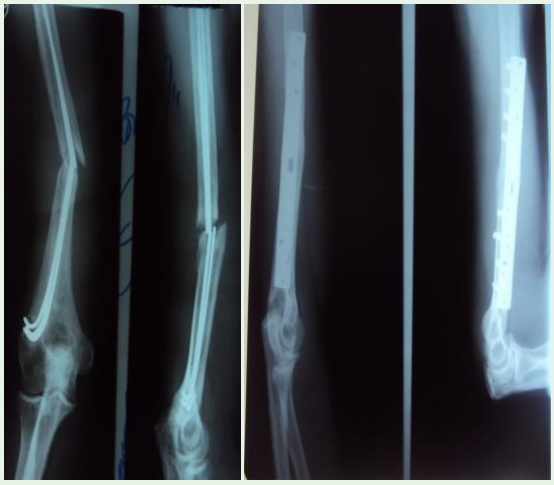

Figure 3: Pseudarthrosis on a spindle treated by screwed plate.

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The mean duration of management of non-union was 5 months with extremes of 2 months and 10 months (Figure 4).

Therapeutic evaluation

At the average follow-up of 18 months we obtained consolidation in all our patients in an average delay of 5 months (extreme: 3 months and 10 months). A shortening of the arm was noted in 22.72% of patients. The study of the strength showed a reduction of it to 10% in 4 patients (This is what justifies our good, average and bad results).

We have not noticed elbows or fingers stiffness in all our patients.

Six cases of radial nerve paralysis were observed after surgical treatment, 4 of which were regressed and 2 remained permanent. In the latter, this paralysis was present before the cure and a section of the nerve was observed at first. We carried out a tendinous transfer in one of the patients with a recovery of the extension of the wrist and the fingers. The latter did not accept the intervention.

According to the criteria of Stewart and Hundley [11,16], we obtained over 80% very good and good results.

Favoring Factors

The occurrence of shaft non-union is common to all fracture sites and is related to the initial lesion, patient and / or treatment and its follow-up.

In our series, non-union occurs mainly in adults with an average age of less than 50 years according to the literature [1,3,8,9,12,40]. These are young patients in full activity who are more exposed to trauma and therefore to their complications. This is a disabling pathology considering the important constraints exerted on the humerus during the movements of the upper limb.

A number of factors are regularly implicated for their role in the evolution towards the non-union of humeral shaft fractures. The elements related to the patient's condition are accepted by the majority of the authors and confirmed by the various studies [2,5,9,12]. These include obesity, smoking, alcoholism and osteoporosis [1,2,10,15,39]; which our study did not find because only obesity is found in 2 patients. Non-union of the humerus complicates above all a fracture with a single transverse or oblique line located at the middle third or distal third [8,9,10,12,15,24,32,33] because of their small contact surface, and hence a lower osteogenic potential [2,9,10]. According to Caroll's anatomical study [7], the main alimentary artery of the humerus is located at its medial edge at the middle third. The trauma can then injure this artery and compromise the vascularization necessary for a good consolidation. The open fracture is not a determining factor in the genesis of the non-union because in our 22 patients, only one had an open fracture. On the other hand, it constitutes an aggravating circumstance in the same way as the comminuted fracture site [9,37,39]. One of the most incriminating factors in the genesis of non-union is the type of treatment of the initial fracture. In this series, 3 types of initial treatment are performed. In addition to the surgical treatment that involved more than half of the cases, we had orthopedic treatment and as a recurrent and frequent occurrence in Africa, the treatment made by bone-setters. Whatever the initial treatment, non-union remains an indirect and formidable complication [4,5,16,29,32,33]. Indeed orthopedic treatment, whether by plaster or by directional splint well conducted gives more than 90% consolidation [2,4,5,9,29]. On the other hand, surgical methods, either by ascending fasciculated insertion or by centromedullary nailing or by screwed plate, are considered to be the largest providers of non-union of the humerus [4,5,9,11,12,29]. The occurrence of non-union in our serie is related to a fault in the treatment. A relationship was found between the number of spindles and the type of non-union. The latter is interrelated with the mobility of the fracture focus. Thus, the more the focus moves, the more the non-union becomes hypertrophic as evidenced by our results. The hypertrophic forms are essentially found after a nailing badly filling the medullary canal while the synthesis by plate gives more eutrophic non-union and no hypertrophic form. However, it does not allow us to assert with certainty this interpretation because our sample is small. For plaque synthesis, the number of screws and the type of plate used played an important role in the occurrence of non-union. The average of the screws was 5 per patient with a narrow plate use unsuited to the constraints of the humerus.

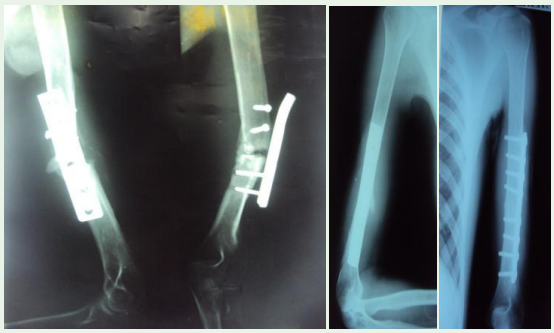

Figure 4: Armed pseudarthrosis on plate treated by screwed plate.

Thus, we can say that the non-union of the humeral shaft is not the direct consequence of the choice of the treatment initially used (whether surgical or orthopedic), but rather it is related to the way in which this treatment is applied. It may be either persistent diastasis, poor supervision of orthopedic treatment with manipulation of a poorly warned radiologist, short or narrow plate, insufficient number of screws or a nailing which does not filling the medullary canal of the shaft with often a short lever arm.

Evaluation of Treatment

If the factors predicting the evolution towards non-union are relatively consensual, the debates concerning its management remain more controversial.

Several techniques have been described in their management.

Self-compressive plate fixation combined with corticospongy auto-graft after open reduction is the method of choice in our study. We have approached the humerus by the antero-external route, the most commonly used pathway, which permits a perfect exposure of all the 1/3 middle of the shaft with the possibility of extension [2,10,17,25]. However, this route imposes isolation and dissection of the radial nerve, especially if there is an initial lesion of this nerve. Excision of the non-union focus was an essential step in our case. On the other hand, BRILHAULT and FAVAR [2,6] consider that this gesture, intended to excise all the fibrous tissue of non-union, is not always necessary. In our series, this gesture allowed us to

correct and to control the axial deviations and to obtain an excellent confrontation of the banks which are re-cut in order to exert a good compression. The osteomuscular decortication represented a basic gesture in our treatment of non-union. Its principle was clearly stated by Judet [2,19,41] father of the technique. The permeabilization again of the medullary canal was practiced for all our patients in order to restart the vascularization of the focus of non-union.

In our series autologous bone grafting was performed in 18 of 22 cases according to the condition of the banks and bone fragments on site. The role of these grafts is double: to induce consolidation and to fill partial or segmental bone defects. In the literature and in the cures of non-union using a screwed plate, the graft seems to play a primordial role and several authors have reported it [1,2,8,10,12,16,18,21,35]. Thus the osteosynthesis by screwed plate is mainly used. It is the only technique allowing, in the same gesture, to ensure a good stabilization of the non-union focus, to control the radial nerve, while providing an osteogenic complement indispensable for consolidation. Moreover, it protects against exposure to X-rays. The constraints to which the humerus is subjected are important, it is therefore essential to have a solid fixation ensured by a large and thick plate of at least 3 mm with at least 8 cortical takes, ie, 3 to 4 screws of type 4.5 bi cortical on each side of the non-union focus ensuring inter-fragmentary compression [3,9,12,14,16,18,29,34,36] .

The pre-molded plates of Lecestre® type were used for the non-union of the 1/3 distal union 1/3 medium to ensure a sufficient lever arm for a good distribution of the screws. Since compression is not possible in this case, a longer consolidation period (10 months) is observed in one of the patients. Despite this delay in this patient, our overall consolidation rate, which is 100% for 22 patients, shows that the screw plate technique is reliable even if our sample is reduced. This rate is around 95% for external fixators as well as screwed plates with less consolidation time than the latter [2,9,12,16,29,32,33,36]. To all these arguments are added the duration of hospitalization which is on average one week [4,26,32]. But the wide opening of the non-union, the possibility of traction on a neurological element, the high infectious risk and, above all, the poor performance of the screws in the case of osteoporosis, constitute the reproaches of this technique [1,2,8,9].

The external fixator is also a type of treatment regularly used in the non-union of the humerus especially in the management of septic forms. . But some authors use it systematically in this pathology [3,8,9,13,22,26,30]. The principle is to obtain a stable osteosynthesis by a non-invasive method making it possible to compress the focus of non-union according to the technique of Ilizarov. This method allows a gradual reduction of the focus with consolidation rates greater than 90% comparable to those of the plate [3,9,20,30]. But it is often responsible for discomfort for the patient because the material is bulky and is the source of neurological complications associated with infection of the orifices of the plugs or pins [3,9,22].

As for the centromedullary nailing which is more indicated in case of aseptic non-union without loss of bone substance [3,10,23,31] and without radial paralysis, its indications are much more controversial. Numerous studies have highlighted the failures of this technique [9,27,31], namely insufficiency of primary stability, the need for a shine enhancer, rotator cuff lesions during the approach and attack of the endomedullary vascularization of the humerus. However, this technique has the advantage of not opening the focus of non-union which would decrease the risk of iatrogenic lesions of the radial nerve and infection of the focus.

From the point of view of functional evaluation, the method of treatment with plate is accompanied by an excellent score according to the criteria of Stewart and Huntley because the rotator cuff is respected in the same way elbow and functional rehabilitation is possible in post immediate surgery [3,32,36,38,40,41].

Conclusion

Non-union is a disabling complication of shaft fractures of the humerus. Etiological factors are inherent in poor initial fracture management. Its management always remains a problem for the surgeon. For us the cure according to judet with fixing by a wide plate for the middle 1/3 or a pre-molded plate of Leceste® type for the 1/3 lower union 1/3 medium keeps our preference, it makes it possible to obtain good results and allowed us to have 100% consolidation.

References

1. Abalo A, Ekoue DD, Komlan A, Atsi W. Open reduction and internal fixation of humeral non-unions: radiological and functional results. ActaOrthop. Belg. 2011; 77: 299-303.
2. Allagui M, Bannour S, Hamdi MF, Amara K. Traitement de pseudarthrose aseptique de la diaphyse humerale par plaque vissee auto-compressive. A propos de 17 cas. Tunisie orthopedique. 2011; 4: 47-51.
3. Atalar Ata Can, Kocaoglu M, Demirhan M. Comparison of Three Different Treatment Modalities in the management of humeral Shaft Non-union (Plates, Unilateral, and Circular External Fixators). J Orthop Trauma. 2008; 22: 248-257.
4. Bardouni El, Mahfoud M, Oudghiri M, Berrada MS. Pseudarthrose aseptique de la diaphyse humerale. Clinique Universitaire de Traumatologie-Orthopedie-CHU Ibn SINA-RABAT. 47-50
5. Beguin J.M, Plenevaux P, Poilvache G. Considerations a propos du traitement des pseudarthroses de l'humerus. Acta OrthopaedicaBelgica. 1991; 57: 2
6. Brilhault J, Favard L. Traitement chirurgical des pseudarthroses diaphysaires aseptiques. EMC-Rhumatologie Orthopedie 2. 2005; 217-247.
7. Caroll SE. A study of the nutrient foramina of the humeral diaphysis. J Bone Joint Surg. 1963; 45: 176-181.
8. Chantelot C, Ferry S, Lahoude-Chantelot S, Prodomme G. Etude retrospective des resultants du traitement chirurgical de 21 pseudarthroses de l'humerus. Elsevier Chirurgie de la main 24. 2005; 84-91.
9. Chantelot C, Robert G, Aihononnou T, Guegen G. Interêt du fixateur externe dans le traitement des fractures de l'humerus: a propos de 23 fixateurs Orthofix. Chir Main. 2002; 21: 134-139.
10. Diarra Abdoulaye Issa. Etude des pseudarthroses aseptiques de la diaphyse humerale dans le service orthopedique et traumatologique du CHU Gabriel Toure. A propos de 14 cas. These Med. Bamako. 2008.
11. Dieme CB, Abalo A, Sane AD, Fall D. Embrochage centromedullaire ascendant des fractures diaphysaires de l'humerus de l'adulte. Evaluation des resultats anatomiques et fonctionnels a propos de 63 cas. Elsevier Chirurgie de la main 24. 2005; 92-98.
12. Dieme C.B, Lakim M, Sy M.H, Sane AD. Pseudarthrose de la diaphyse humerale au CHU de Dakar. A propos de 19 cas. Revue Africaine de chirurgie. 2003, 6: 43-46.
13. EL Rosasy MA. Non-united humeral shaft fractures treated by external fixator augmented by intramedullary rod.
14. Indian JOrthop. 2012; 46: 58-64.

15. Farouk O, EssamEl.S, Mostafa K, Khalil A. Intramedullary fibular graft and quadricortical plate fixation in atrophic non-union of the osteoporotic humerus. Injury Extra. 2008; 39: 152-154.

16. Foulk DA, Szabo RM. Diaphysealhumerus fractures: Natural History and occurrence of non-union. Orthopaedics. 1995; 18: 333-335.

17. Gogoua DR, Anoumou M, Kouame A, Guedebge F. Resultats du traitement de la pseudarthrose aseptique de la diaphyse humerale par plaque vissee et autogreffe osseuse a propos de 20 cas. Mali Medical. 2006; T XXI: 10-14.

18. Honnart F. Voies d'abord en chirurgie orthopedique et traumatologique. Masson. 3: 32-37.

19. Hierholzer C, Sama D, Toro J.B, Peterson M. Plate fixation of un-united humeral shaft fractures: Effect of type bone graft on healing. JBJS.ORG. 2006; 88: 1442-1447.

20. KAMINA Pierre. Anatomie clinique 4th edition, Tome 1: Anatomie generale-membres. Maloine. Paris. 2011; 219-223.

21. Kesemenli C.C, Subasi M, Arslan H, Necmioglu S, Kapukaya A. Treatment of humeral diaphysealnonunions by interlocked nailing and autologous bone grafting. ActaOrthopaedicaBelgica. 2002; 68: 5.

22. Kocoaglu M, Tomak Y, Eralp L, Bilen FE. The treatment of pseudarthrosis of the humeral shaft by the Ilizarov method. ActaOrthopTraumatolTurc. 2001; 35: 1-9.

23. Kontakis GM, Papadokostakis GM, Alpantaki K. Intramedullary nailing for non-union of the humeral diaphisis: A review. Injury, Int. J. Care Injured. 2006; 37: 952-960.

24. Lammens J, Bauduin G. Treatment of non-union of the humeral is using the ilizarov external fixator. ClinOrthop 1998; 353: 223-230.

25. Laporte C, Biette g, Jouve F, El Barnoussi A. Les differentes voies d'abord pour osteosynthèse par plaque des deux tiers distaux de l'humerus. Maitrise orthopedique Nº128-Novembre 2003.

26. Lavini F, Brivio LR, Pizzoli A. Treatment of non-union of the humerus using the Orthofix® external fixator. Injury, Int. J. Care Injured 32(2001) S-D-35-S-D-40

27. Martinez AA, Herrera A, Cuenca J. Marchettinailing with decortication and bone graft in non-unions of the two upper thirds of the humerus. Elsevier Chirurgie de la Main. 2002; 21: 28-32.

28. Meyrueis JP, Cazenave A. Consolidation des fractures. Elsevier SAS. 2004; 1:138-162.

29. Obert L, Couesmes A, Lepage D, Pauchot J. Consolidation osseuse et pseudarthrose des os longs: l'apport des BMP. e-memoires de l'Academie Nationale de Chirurgie. 2007; 6: 24-30.

30. Patel VR, Menon DK, Pool RD. Nonunion of the humerus after failure of surgical treatment. Management using the Ilizarov circular fixator. J Bone Joint Surg [Br]. 2000; 82: 977-983.

31. Pietu G, Letenneur J, Bourgade M. Le clou humeral de Seidel dans les indications limites: fracture pathologiques, retard de consolidation, pseudarthroses et reconstructions. Acta OrthopBelg. 1994; 60: 187-193.

32. Rahmi M, Arssi M, Doumane B, Cohen D. Les pseudarthroses aseptiques de la diaphyse humerale. Rev. maroc.chir.orthop.traumato. 2001; 4: 39-45.

33. Raissouni Z, kasmaoui H, Bouabid S, Chagar B. Place de l'osteosynthèse par plaque vissee dans le traitement de la pseudarthrose aseptique de la diaphyse humerale «15 cas». Rev.maroc.chir.orthop.traumato. 2007; 30: 27-31.

34. Ramoutar DN, Rodrigues J, Quah C, Boulton C. Judet decortication and compression plate fixation of long bone non-union: Is bone graft necessary? Injury, Int. J. Care Injured. 2011; 42: 1430-1434.

35. Rosen H. The treatment of non-unions and pseudoarthroses of the humeral shaft. OrthopClin North Am. 1990; 21: 725-741.

36. Segons JM, Alnot JY, Masmejean E. Pseudarthroses et retard de consolidation aseptiques de la diaphyse humerale: A propos de 30 cas traites par plaque vissee et autogreffe. Revue de chirurgie orthopedique et reparatrice de l'appareil moteur. 2003; 89: 107-114.

37. Simonis RB, Nuñez VA, Khaleel A. Use of the Covertry infant hip screw in the treatment of nonunion of fractures of the distal humerus. JBJS [Br]. 2003; 85-B: 74-77.

38. Sugun TS, Ozaksar K, Kayalar M. Humeral shaft non-unions: plate and nails. Eklem Hastalik cerrahisi. 2012; 23: 150-155.

39. Tryherleigh-Strong G, Walls N, MacQueen MM. The epidemiology of humeral shaft fractures. J Bone Joint Surg. 1998; 80: 249-253.

40. Tzu-Lang H, Fang-Yao C, Chuan-Mu C, Tain-Hsiung C. Treatment of nonunion of humeral shaft fracture with dynamic compression plate and cancellous bone graft. J Chin Med Assoc. 2005; 68: 73-76.

41. Verbruggen JPAM, Stapert JWJL. Failure of reamed nailing in humeral non-union: an analysis of 26 patients. Injury, Int.J. Care Injured.2005; 36: 430-438.

42. Zinghi GF. La pseudarthrose diaphysaire de l'humerus. Resultats cliniques et radiologiques sur 147 cas operes. Acta. Orthop. Bel. 1986; 52: 19-35.