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Outcome of Surgical Treatment of Adult's Olecranon Fracture in Yaoundé

Résultat du Traitement Chirurgical de la Fracture de l'Olécrane de l'Adulte à Yaoundé

Fonkoue Loïc^{1,2}, Ngongang F. Olivier³, Mbaga Ntjam André Claude¹, Ndjou'ou, Osse Maginot Stéphane¹, Muluem O. Kennedy^{1,2}, Umaru Chifen¹, Mohamadou Guiemse¹, Nyeckel Raphaela¹, Ngo Yamben Marie Ange¹, Guifo Marc Leroy¹, Handy E. Daniel^{1,4}

Affiliations

1. University of Yaounde 1, Faculty of Medicine and Biomedical Sciences, Department of Surgery and Specialties
2. Department of Orthopaedics and Traumatology, Yaounde General Hospital.
3. Department of Orthopaedics and Traumatology, Yaounde Emergency Centre
4. Department of Orthopaedics and Traumatology, Yaounde Central Hospital

Auteur correspondant

Dr Fonkoue Loïc

Tel : +237 699666757

Email : fonkoueloic@yahoo.fr

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RÉSUMÉ

Introduction. Multiple surgical options exist for the treatment of olecranon fractures. The aim of our study was to describe and compare the results of different olecranon fracture fixation techniques in five hospitals in the city of Yaoundé. **Methodology.** We conducted a retrospective cohort study in five university hospitals in the city of Yaoundé. Included were all patients over 18 years of age who underwent surgery for olecranon fracture between January 2015 and December 2020, and were followed up for at least 6 months. **Results.** We studied 59 adults. The mean age was 33.4 ± 12.7 years with a sex ratio M/F of 3.9. Twenty (33.9%) fractures were type I, 30 (50.8%) were type IIA, and 9 (15.2%) were type IIB. The types of fixations were Tension-band Wiring (TBW) in 50 (84.7%) cases and Plate Fixation (PF) in 9 (15.3%) cases. Type I and IIA fractures were fixed by TBW, while all IIB fractures were fixed by PF. The overall consolidation rate was 93.2%. The most common complications were elbow stiffness (23.7%) and cutaneous impingement of osteosynthesis material (6.7%). The mean MEPI score was 85.6 ± 12.9 and the functional score was good to excellent 81.5% of the cases. There was no significant difference between the two types of fixations, apart from elbow stiffness, which was more common in PF (OR= 0.17; 95% CI: 0.03-0.78; p=0.02). **Conclusion.** Tension-band wiring and Plate fixation give good results in the treatment of olecranon fractures in Yaounde. Apart from elbow stiffness, there was no significant difference in outcome between the two techniques.

ABSTRACT

Introduction. Plusieurs options chirurgicales existent pour le traitement des fractures de l'olécrâne. L'objectif de notre étude était de décrire et de comparer les résultats de différentes techniques de fixation des fractures de l'olécrâne dans cinq hôpitaux de la ville de Yaoundé. **Méthodologie.** Nous avons mené une étude de cohorte rétrospective dans cinq hôpitaux universitaires de la ville de Yaoundé. Ont été inclus tous les patients de plus de 18 ans ayant subi une chirurgie pour une fracture de l'olécrâne entre janvier 2015 et décembre 2020, et ayant été suivis pendant au moins 6 mois. **Résultats.** Nous avons étudié 59 adultes. L'âge moyen était de $33,4 \pm 12,7$ ans avec un ratio hommes/femmes de 3,9. Vingt (33,9%) fractures étaient de type I, 30 (50,8%) étaient de type IIA et 9 (15,2%) étaient de type IIB. Les types de fixations étaient le cerclage tendineux (CT) dans 50 (84,7%) cas et la fixation par plaque (FP) dans 9 (15,3%) cas. Les fractures de type I et IIA ont été fixées par CT, tandis que toutes les fractures de type IIB ont été fixées par FP. Le taux de consolidation global était de 93,2%. Les complications les plus courantes étaient la raideur du coude (23,7%) et la pincement cutané du matériel d'ostéosynthèse (6,7%). Le score MEPI moyen était de $85,6 \pm 12,9$ et le score fonctionnel était bon à excellent dans 81,5% des cas. Il n'y avait pas de différence significative entre les deux types de fixations, à l'exception de la raideur du coude, qui était plus fréquente dans la FP (OR= 0,17; IC à 95 %: 0,03-0,78; p=0,02). **Conclusion.** Le cerclage tendineux et la fixation par plaque donnent de bons résultats dans le traitement des fractures de l'olécrâne à Yaoundé. Mis à part la raideur du coude, il n'y avait pas de différence significative dans les résultats entre les deux techniques.

HIGHLIGHTS**What is known of the subject**

Several techniques for fixing the olecranon fracture exist, but the most commonly used are tension-band wiring (TBW) and plate fixation

The aim of our study

Outcome of surgical treatment of olecranon's fracture in Yaoundé

Key Results

1. The mean age of patients was 33.4 ± 12.7 years and the sex ratio M/F was 3.9.
2. The types of fixations were tension-band wiring (TBW) in 50 cases (84.7%) and plate fixation (PF) in 9 cases (15.3%).
3. Type I and IIA fractures were fixed by TBW, while all IIB fractures were fixed by PF.
4. The mean Mayo Elbow Performance Index (MEPI) score was 85.6 ± 12.9 and the functional score was good to excellent for 81.5% of patients.
5. There was no significant difference between the two types of fixations, apart from elbow stiffness, which was more common in PF (OR= 0.17; 95% CI: 0.03-0.78; p=0.02).

INTRODUCTION

Olecranon fractures account for 10% of fractures around the elbow [1]. These are articular fractures requiring anatomical reduction, stable fixation, and early mobilization to restore elbow function. Several techniques for fixing the olecranon fracture exist, but the most commonly used are tension-band wiring (TBW) and plate fixation (PF) [2–4]. In literature from developed countries, where these osteosyntheses are performed under fluoroscopic control for optimal positioning of the implants, there is no consensus on the superiority of one technique over the other [2,5]. However, a few studies have shown that TBW was more associated with skin irritation and a higher recovery rate, compared to PF [6–10] which was more associated with severe complications [11]. In these studies, TBW involved a bicortical K-wire fixation, and was performed under fluoroscopic control. In a resource-limited environment where patients are operated on without an image intensifier, TBW with intramedullary pinning is technically more feasible than conventional TBW with bicortical K-wire fixation. However, in sub-Saharan Africa, there is little data on the results of this technique compared to PF. Our aim here was therefore to describe the methods of fixation of olecranon fractures and to compare their results in Yaoundé.

PATIENTS AND METHODS

We conducted a retrospective cohort study over six years and in five university hospitals in the city of Yaoundé. The Institutional Research Ethics Board approved this study. We included all patients aged 18 years or older, operated on for an olecranon fracture between January 1st, 2015 and December 31st, 2020, followed up for at least 6 months, and who freely consented to participate in the study. Unusable records and patients lost to follow-up were excluded. Data was collected from

patients' medical records and operative reports. Each patient was then invited for the ultimate radiological and clinical evaluation which was performed by two orthopedic surgeons. Variables of interest were sociodemographic, fracture type according to the Mayo Clinic classification, fixation method, radiological and functional outcomes according to the Mayo Elbow Performance Index (MEPI) [12], and complications.

The series

Out of 71 patients operated for an olecranon fracture during this study period, eight were excluded for unusable records and four did not respond to the invitation to participate. Thus, a total of 59 patients, including 47 (79.7%) men, with a mean age of 33.3 ± 12.7 years, were included in the study.

The injuries were on the left side in 35 (59.3%) cases and were due to traffic accidents in 32 (54.2%) cases.

Sociodemographic and clinical data are summarized in **Table 1**. Twenty (33.89%) fractures were type I, 30 (50.84%) were type IIA, and 9 (15.25%) were type IIB. There were 10 (16.9%) open fractures, Gustilo-Anderson types 1 and 2. The mean time to surgery was 5.8 ± 5.2 days.

The types of fixations were TBW with intramedullary pinning in 50 (84.7%) cases and PF in 9 (15.3%) cases (**Figure 1**). Regarding the indications, the type I and IIA fractures were fixed by TBW while all the IIB fractures were fixed by PF. Of the patients treated with TBW, 33 (66%) had short pins (limited to the proximal 1/3 of the Ulna) and 17 (34%) had long pins (1/3 middle of the ulna and beyond). All interventions were carried out without an image intensifier.

Postoperative immobilization for 3 weeks was the protocol. All patients received 7 to 10 days of postoperative antibiotics, according to standard service protocols. The average length of hospital stay was 4.9 ± 2.8 days. Rehabilitation was carried out by a physiotherapist in 39 (66.1%) cases, and the remaining patients had no rehabilitation (3.4%) or self-rehabilitation (30.5%). The mean follow-up at the ultimate assessment of patients was 25.3 ± 8.4 months.

Statistics

Data were analysed using SPSS.26 (Statistical Package for Social Sciences) software. Qualitative variables were expressed as number and frequency; Quantitative variables were expressed as means and standard deviations. For the comparison of quantitative variables, we used Student's T-test for independent data in case of normal distribution or Mann's Whitney-U test for nonparametric data. The chi-square test or Fisher's exact test were used for the comparison of qualitative data. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Of the 59 cases of olecranon fracture found in our study, the average age of the patients was 33.37 years, with a sex ratio of 3.9 (**Table I**). Immediate and early complications were found in 4 (6.7%) cases, including 2 cases of secondary displacement of the fracture line, 1 case of implant failure and 1 case of surgical site infection. Late complications and sequelae were found in

17 (28.8%) patients, mainly elbow stiffness in 14 (23.7%) patients (**Table 2**). At the last follow-up, bone union was achieved in 55 (93.2%) patients, and 47 (79.7%) had removed the implant.

Table 1. Characteristics of the study population

Data	N=59	%
Gender		
Male	47	79.7
Female	12	20.3
Mechanism		
RTA	32	54.23
Aggression	11	18.64
Sports injury	6	10.16
Fall	9	15.25
Domestic accident	1	1.69
Comorbidities		
Diabetes	3	5.1
Hypertension	4	6.8
HIV Infection	1	1.7
Smoking	1	1.7
Laterality (affected side)		
Left	35	59.3
Right	24	40.7
Mayo Clinic Classification		
Type I	20	20.3
Type IIA	30	64.5
Type IIB	9	15.2
Type of fixation		
TBW	50	84.75
Short pins	33	66
Long pins	17	34
PF	9	15.25

RTA: Road Traffic Accident; TBW: Tension Band Wiring; PF: Plate Fixation

Table 2. Complications depending on the type of fixation

Complications	TBW, N=50	PF, N=09
Skin impingement	04	00
Pin migration	02	00
Loosening	01	00
Elbow stiffness	09	05
Arthritis	01	00
Pseudarthrosis	02	02
Infection	00	01

TBW: Tension Band Wiring; PF: Plate Fixation

Table 5. Comparison of results by surgical fixation technique

Variables	Definitive treatment		OR (CI at 95%)	P	
	TBW	PF			
Quality of reduction					
Anatomic reduction	Yes	26	7	0.31 (0.05_1.63)	0.27
	No	24	2		
Functional reduction	Yes	18	2	1.96 (0.36_10.50)	0.48
	No	32	7		
Unsatisfactory reduction	Yes	4	0	1.19 (1.06_1.34)	0.61
	No	46	9		
Late complications	Yes	15	5	0.34 (0.81_1.45)	0.249
	No	35	4		
Skin impingement	Yes	4	0	1.19 (1.06_1.34)	0.61
	No	46	9		
Loosening of implants	Yes	1	0	1.18(1.06_1.32)	0.66
	No	49	9		
Elbow stiffness	Yes	9	5	0.17(0.03_0.78)	0.02
	No	41	4		
Arthritis	Yes	1	0	1.18 (1.06_1.32)	1.00
	No	49	9		

The mean time to consolidation was 3.3 ± 0.5 months (range: 3-5 months). Post-traumatic osteoarthritis of the elbow was found in 1 (1.7%) patient. In the anatomical assessment of the quality of fracture reduction (**Table 3**), the reduction was judged to be anatomical in 33 (55.9%) cases, sub-anatomical in 15 (24.4%) cases, and poor in 11 (18.6%) cases.

Table 3. Radiological and Clinical evaluation of patients

Variables	N	%
Score fonctionnel (MEPI)		
Excellent (de 90 to 100)	20	33.9
Good (75 to 89)	28	47.5
Average (60 to 74)	8	13.6
Bad (0 to 60)	3	5.1
Quality of the reduction		
Anatomic reduction	33	55.9
Sub-anatomic reduction	15	24.4
Poor reduction	11	18.6
Patient Satisfaction		
Very satisfied	51	86.4
Satisfied	4	6.8
Not Satisfied	4	6.8

The mean elbow flexion was 128.3 ± 11.1 degrees, the extension deficit 31.7 ± 11.2 degrees, resulting in an average elbow range of motion of 96.59 ± 5.84 degrees. The mean MEPI score was 85.6 ± 12.9 (range: 45 – 100); the functional outcome was rated as excellent in 20 (33.9%) cases and good in 28 (47.5%) cases. Patients were very satisfied in 51 (86.4%) cases.

Table 4. Comparison of results based on surgical technique

Variables	Mean values (SD)		Pvalue	CI
	TBW	PF		
Delayed consolidation	3.38 (0,56)	3.11 (0,33)	0.175	0.12-0.66
Mayo clinic Score	85.60 (13.50)	86.11 (9.93)	0.974	4.72-9.98
Elbow extension amplitude	31.36 (11.51)	33.89 (9.93)	0.539	4.09-10.72

TBW: Tension Band Wiring; PF: Plate Fixation

Analytically, there was no significant difference between PF and TBW for consolidation time, MEPI functional score, and elbow range of mobility (**Figure 2, Table 4**).



Figure 1. fixation techniques used ; A, TBW with short intramedullary pins ; B, Plate fixation



Figure 2. A, TBW with long intramedullary pins ; B, TBW with short intramedullary pins , note the loosening of implants, the skin impingement and nonunion of the olecranon.

On the other hand, there was a significant association between elbow stiffness and PF (OR= 0.17; 95% CI: 0.03-0.78; $p=0.02$). In fact, PF increased the risk of having elbow stiffness by 83% (**Table 5**). When comparing TBW with short-pin intramedullary versus long pins, the elbow extension deficit was significantly higher in short-pin tension-band wiring ($34.1 \pm 12.2^\circ$ vs. $25.8 \pm 9.9^\circ$; $p=0.01$).

DISCUSSION

The aim of this study was to evaluate the anatomical and functional outcomes of the surgical treatment of olecranon fractures in Yaounde according to the technique used. We found that the results were generally satisfactory with a bone consolidation rate of 93% at an average time of 3.3 months, a good to excellent elbow functional score in 81.5% and 86% of patients very satisfied. However, late complications are found in 28% of patients, mainly a decrease in the range of motion of the elbow (23%). We did not find a significant difference in outcome between PF and TBW with intramedullary pinning, apart from elbow stiffness, which was significantly more common with plating. Of the 59 cases of olecranon fracture found in our study, the average age of the patients was 33.37 years, with a sex ratio of 3.9;

this average age is below most of the data in the literature[2,5,13,14]; this is probably due to the fact that the Cameroonian population is mostly young and the male youth is strongly involved in high-risk occupations such as motorcycle taxis. The fractures were mostly type 2A, which coincides with the majority of the data in the literature[2,5,13,14], moreover we have 33.89% of type 1 lesions, the operative indication here was probably the young age of our patients with a high functional demand. The means of fixation used in our study were mainly TBW with intramedullary pinning, followed by plating. This predominance of TBW is due to the fact that this technique is considered by some authors to be the gold standard for the surgical treatment of olecranon fractures[6,13]. Plating has been used exclusively in type 2B fractures; this preference may be due to the fact that TBW is more difficult to perform in comminuted olecranon fractures and the reduction is often poor [15,16]. Powell AJ et al also recommends PF in comminuted fractures[17]. Our results reflect data from the literature that present TBW and PF as the main fixation methods. There are other methods of fixing olecranon fractures such as pinless strapping [18], high strength suture tension banding [19] and intramedullary nailing of the ulna [20]; the results of which appear to be

better than those of traditional techniques, but there are not enough studies to date to be able to recommend them. In our study, we used only TBW with intramedullary pinning, yet the literature recommends TBW with bicortical or even tricortical K-wire fixation which are more stable [21-24]. The latter require an image intensifier that we didn't have. Nevertheless, our results show satisfactory results with TBW with intramedullary pinning and suggest the use of long intramedullary pins which would provide more stability. A biomechanical study comparing short-pin versus long-pin TBW with intramedullary pinning could be used to evaluate this hypothesis. Consolidation was acquired in all patients with a mean time of 3 months, and there was no significant difference between the two types of fixations. Most studies [2,5] describe a good rate of consolidation of olecranon fractures and is similar between the two types of fixation. The main early complications were skin irritation, loosening of the pins, these complications were more common in TBW, these two complications and a repeat surgery have been observed by a good number of authors [6-10,13] in TBW. The most common chronic complication was elbow stiffness (23.7%), this complication was more associated with the plate fixation. This trend could be explained by the fact that plate fixations were made on the most complex and unstable fractures (2B). The functional prognosis ranged from good to excellent; As many studies before ours have shown, there was no significant difference between TBW and plate fixation. However, some authors such as Yi-Ming Ren et al [5] found that plate fixation presents fewer complications and recommend it as an optimal choice.

CONCLUSION

This study finds that TBW with intramedullary pinning and plate fixation are the two means of fixing olecranon fractures used in Yaounde, with an exclusivity of the plate fixation for type 2B fractures. The results are satisfactory with a bone consolidation rate of 93% at 3.3 months. Functional recovery is good to excellent in 81.5% of patients and patients are very satisfied in 86% of cases. The main complication is elbow stiffness (23%), which is significantly more common in patients operated by plate fixation, probably due to selection bias. Apart from elbow stiffness, there is no significant difference in outcome between the two techniques.

Limits of the study

Its retrospective nature, the lack of prior standardization of surgical techniques that were more dependent on the surgeon, and the sample size. Nevertheless, the high rate of patients who were well monitored reviewed and evaluated during the study made it possible to obtain reliable results allowing accurate analyses and conclusions useful to the scientific community

Conflict of Interest

The authors declare that they have no conflict of interest

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Authors' contribution

All authors participated in the writing and editing of this manuscript

REFERENCES

- Rommens PM, Küchle R, Schneider RU, Reuter M. Olecranon fractures in adults: factors influencing outcome. *Injury* 2004;35(11):1149-57.
- Rantalaiho IK, Miikkulainen AE, Laaksonen IE, Äärimala VO, Laimi KA. Treatment of Displaced Olecranon Fractures: A Systematic Review. *Scand J Surg SJS Off Organ Finn Surg Soc Scand Surg Soc.* 2021;110(1):13-21.
- Baecher N, Edwards S. Olecranon fractures. *J Hand Surg. J Hand Surg Am;* 2013;38(3).
- Wilkerson JA, Rosenwasser MP. Surgical techniques of olecranon fractures. *J Hand Surg.* 2014;39(8):1606-14.
- Yi-Ming Ren, Hu-Yun Qiao, Zhi-Jian Wei et al. Efficacy and safety of tension band wiring versus plate fixation in olecranon fractures: a systematic review and meta-analysis *J Orthop Surg Res* 2016 Nov 14;11(1):137.
- Chalidis BE, Sachinis NC, Samaladas EP, Dimitriou CG, Pourmaras JD. Is tension band wiring technique the « gold standard » for the treatment of olecranon fractures? A long term functional outcome study. *J Orthop Surg Res* 2008;3.
- Claessen FMAP, Braun Y, Peters RM, Dyer G, Doornberg JN, Ring D. Factors Associated With Reoperation After Fixation of Displaced Olecranon Fractures. *Clin Orthop.* 2016;474(1):193-200.
- Karlsson MK, Hasserijs R, Besjakov J, Karlsson C, Josefsson PO. Comparison of tension-band and figure-of-eight wiring techniques for treatment of olecranon fractures. *J Shoulder Elbow Surg.* 2002;11(4):377-82.
- Phadnis JS, Vaughan A, Luokkala T, Peters J, Watson JJ, Watts A. Comparison of all suture fixation with tension band wiring and plate fixation of the olecranon. *Shoulder Elb.* 2020;12(6):414-21.
- Romero JM, Miran A, Jensen CH. Complications and re-operation rate after tension-band wiring of olecranon fractures. *J Orthop Sci* 2000;5(4):318-20.
- Duckworth AD, Clement ND, White TO, Court-Brown CM, McQueen MM. Plate Versus Tension-Band Wire Fixation for Olecranon Fractures: A Prospective Randomized Trial. *J Bone Joint Surg Am.* 2017;99(15):1261-73.
- Morrey BF, An K-N: Functional evaluation of the elbow. In: Morrey BF (Ed.) *Morrey's the Elbow and its Disorders.* WB Saunders, Philadelphia, PA, 1993, 86 pp.
- Duckworth AD, Clement ND, White TO, Court-Brown CM, McQueen MM. Plate Versus Tension-Band Wire Fixation for Olecranon Fractures: A Prospective Randomized Trial. *J Bone Joint Surg Am.* 2017;99(15):1261-73.
- Liu Q-H, Fu Z-G, Zhou J-L, Lu T, Liu T, Shan L, et al. Randomized prospective study of olecranon fracture fixation: cable pin system versus tension band wiring. *J Int Med Res.* 2012;40(3):1055-66.
- Ikeda M, Fukushima Y, Kobayashi Y, Oka Y. Comminuted fractures of the olecranon. Management by bone graft from the iliac crest and multiple tension-band wiring. *J Bone Joint Surg Br.* 2001;83(6):805-8.
- Gordon MJ, Budoff JE, Yeh ML, Luo Z-P, Noble PC. Comminuted olecranon fractures: a comparison of plating methods. *J Shoulder Elbow Surg.* 2006;15(1):94-9.
- Powell AJ, Faehan-Alanie OM, Bryceland JK, Nunn T. The treatment of olecranon fractures in adults. *Musculoskelet Surg* 2017 Apr;101(1):1-9.
- Cornefjord G, Kostogiannis I, Rogmark C, Jerrhag D, Wenger D. The With Or Without Olecranon K-wire

- (WOW OK) Trial of tension band wire fixation versus cerclage fixation without K-wires in displaced stable olecranon fractures: study protocol for a randomized controlled trial. *Trials*. BioMed Central 2023;24(1):1-11.
19. Bateman DK, Barlow JD, VanBeek C, Abboud JA. Suture anchor fixation of displaced olecranon fractures in the elderly: a case series and surgical technique. *J Shoulder Elbow Surg*. juill 2015;24(7):1090-7.
 20. Nowak TE, Burkhart K, Mueller LP, Mattyasovszky SG, Andres T et al. New intramedullary locking nail for olecranon fracture fixation--an in vitro biomechanical comparison with tension band wiring. *J Trauma* 2010 ;69(5):E56-61
 21. Nowotny J, Bischof F, Ahlfeld T, Goronzy J, Tille E, Nimtschke U, Biewener A. Biomechanical comparison of bi-and tricortical k-wire fixation in tension band wiring osteosynthesis. *Eur J Med Res* 2019; 24:33
 22. Saeed ZM, Trickett RW, Yewlett AD, Matthews TJW. Factors influencing K-wire migration in tension-band wiring of olecranon fractures. *J Shoulder Elbow Surg* 2014;1-6. doi.org/10.1016/j.jse.2014.02.018
 23. Wang K, Lub Ye, Shen Y, Cai W , Zhan S, Ding J. Where should the pins be placed to decrease the failure rate after fixation of a Mayo IIA olecranon fracture? A biomechanical analysis *Injury* 2020; doi.org/10.1016/j.injury.2020.04.018
 24. Van der Linden SC, Kampen AV, Jaarsma RL. K-wire position in tension-band wiring technique affects stability of wires and long-term outcome in surgical treatment of olecranon fractures. *J Shoulder Elbow Surg* 2012; 21:405-411