ORIGINAL ARTICLE

Minimally invasive surgery with Dynamic Hip Screw plate for hip fractures

Lázaro Martínez Aparicio[1]*, Lázaro Martín Martínez Estupiñan[1], Leonardo Martínez Aparicio[1], Sergio Morales Piñeiro[1], Luis Alberto Lugo Pijuan[1]

[1]"Mártires del 9 de Abril" University General Provincial Hospital, Sagua La Grande, Villa Clara, Cuba

***Lázaro Martínez Aparicio. lazaroma93@nauta.cu**

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ABSTRACT

Introduction: minimally invasive surgical techniques have gained interest among orthopedic surgery specialists in the last decade. Hip fractures in the elderly represent a huge socio-health problem because they are an important cause of morbidity, functional loss and mortality in the elderly.
Objective: to carry out a study of the procedure and to protocolize the technique in the service.
Methods: a prospective study of 15 patients who underwent surgery was carried out, using the minimally invasive technique as an approach to place the osteosynthesis, which was performed with the Dynamic Hip Screw plate nail. The study universe consisted of 128 patients admitted with hip fracture between January 1 and December 31, 2019 at the "Mártires del 9 de Abril" Hospital.
Results: the average age of the cases was 77.4 years, the female sex predominated, they generally presented good cognitive conditions and their general condition was good, although the average hematocrit in the preoperative period was low, the use of blood was low thanks to the benefits of the minimally invasive technique, approaches smaller than 4.5 cm and two or three-hole blades, the radiological evolution was satisfactory.
Conclusions: the use of minimally invasive techniques allows a better evolution of surgically operated cases of hip fractures.
Key words: hip fractures; minimally invasive surgery

RESUMEN

Introducción: las técnicas de cirugía mínimo invasiva han ganado interés entre los Especialistas en Cirugía ortopédica en la última década. Las fracturas de cadera en el anciano representan un enorme problema socio-sanitario por ser una causa importante de morbilidad, pérdida funcional y mortalidad en la tercera edad.
Objetivo: realizar un estudio del procedimiento y protocolizar la técnica en el servicio.
Métodos: se realizó un estudio prospectivo de 15 pacientes intervenidos quirúrgicamente, se utilizó la técnica mínima invasiva como abordaje para colocar la osteosíntesis, que se

realizó con clavo placa Dynamic Hip Screw. El universo de estudio lo constituyeron 128 pacientes ingresados con fractura de cadera entre el primero de enero y el 31 de diciembre de 2019 en el Hospital "Mártires del 9 de Abril".
Resultados: la edad promedio de los casos fue de 77,4 años, el sexo femenino predominó, generalmente presentaban buenas condiciones cognitivas y su estado general era bueno, a pesar de que el hematocrito promedio en el preoperatorio era bajo la utilización de sangre fue poca gracias a las bondades de la técnica mínima invasiva, los abordajes menores a los 4,5 cm y las láminas de dos o tres agujeros, la evolución radiológica fue satisfactoria.
Conclusiones: la utilización de técnicas mínimo invasiva permite la mejor evolución de los casos tratados quirúrgicamente con fracturas de cadera.
Palabras clave: fracturas de cadera; cirugía mínimo invasiva

INTRODUCTION

Minimally invasive surgical techniques have gained interest among orthopedic surgery specialists in the last decade. Hip fractures in the elderly currently represent an enormous socio-health problem because they are an important cause of morbidity, functional loss and mortality in the elderly. They commonly occur in old age and intertrochanteric fractures are the most common. The Dynamic Hip Screw (DHS) is a highly recommended osteosynthesis system in patients with osteoporosis that is relatively simple to use and offers secure fixation.
In stable hip fractures, sliding plate screw osteosynthesis is considered the "gold standard" of treatment.[1] A wide threaded lag screw with sliding capability in the fracture plane and support on a lateral plate is used. In order to obtain adequate fixation of the system, a number of fundamental rules must be followed.
In the surgical treatment of hip fractures, regardless of the type of fracture and the technique employed, the experience of orthopedic surgical specialists has proven to be a fundamental factor in the outcome. Orthopedic procedures are associated with substantial blood loss, which can result in increased morbidity and mortality, hospital stay and costs. The demand for this type of surgery has increased secondary to the increase in the prevalence of obesity and the aging population, which forces specialists to seek ways to minimize the associated risks. In these cases, the approach to the lesion is minimized.[2]
There are several known techniques that contribute to blood saving and are frequently used in Orthopedics and Traumatology: pneumatic cuff, rachianesthesia, induced hypotension, normovolemic hemodilution, intraoperative and postoperative blood salvage, the use of drugs that stimulate coagulation and inhibit fibrinolysis, the use of erythropoietin in the preoperative and postoperative period, and minimally invasive surgery.[3]
The elderly patient should not be kept bedridden, so surgical treatment, mobilization and early loading are currently advocated, a condition that can be effectively achieved with DHS. Fracture reduction and stabilization with tube-plate and sliding screw is a widely used technique; other systems have been designed in pursuit of overcoming it, with very disparate results. In order to reduce morbidity and improve the results achieved with this technique, several authors proposed minimally invasive surgery.[4,5]

The present work is intended to begin a study of the procedure and to protocolize the technique in the service, a feasible and fast technique that avoids bleeding and allows early mobilization of the patient.

METHODS

A prospective, descriptive, cross-sectional, case series type study was carried out in 15 patients who presented hip fracture and who underwent minimally invasive surgery between January 1 and December 31, 2019 at the General Provincial University Hospital "Mártires del 9 de Abril" in the City of Sagua la Grande, Villa Clara Province; they were chosen by inclusion and exclusion criteria and operated by the same surgical team, from a universe of 125 patients with hip fractures.
The minimally invasive technique was used as the approach to place the osteosynthesis, which was performed with a DHS nail plate (Figure 1).

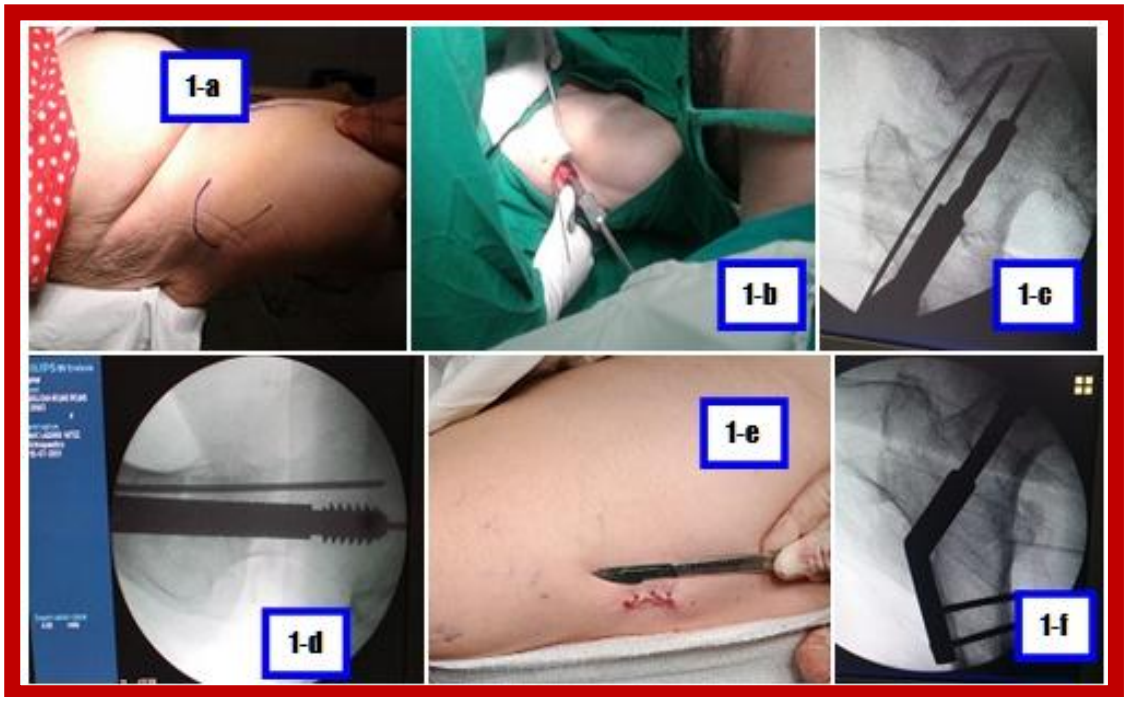

Figure 1. Minimally invasive surgical procedure for osteosynthesis in hip fracture with DHS nail plate
a: surgical planning; b: positioning for nail reaming; c: reaming of the canal for compression nail placement; d: tangential view of the canal at the neck and placement at the femoral head; e: minimal approach for the operation; f: final position of the osteosynthesis

Inclusion criteria:

- Provide consent to participate in the study.
- To present hip fracture type 31A and 31B according to the AO group classification.
- Belong to the municipalities of Corralillo, Quemado de Güines, Sagua la Grande and Cifuentes, which correspond to the regionalization of the hospital.

Exit criteria:

- Abandoning follow-up by the service or being sent to another institution for causes other than hip fracture.

A survey form was prepared (name and surname, age, sex, home address, telephone, municipality of origin, date and time of fracture, cognitive status, general condition, type of fracture, affected limb, size of the cephalic screw, number of the lamina hole, surgical time and bleeding during and after surgery) which was filled in as the cases were operated on.

Radiological evolution was another study variable and was divided into three categories:

- Good: radiological signs of consolidation in the appropriate period.
- Regular: delayed consolidation
- Bad: no consolidation or pseudoarthrosis.

For the processing and analysis of the information, descriptive statistics with absolute and relative frequency distribution and measures of central tendency such as mean, standard deviation, mode, mode, ratio and percentage analysis were used, supported by the Excel software of the Office 2010 package for Windows.

Ethical considerations were taken into account in the research and the commitment to use the data obtained strictly for the proposed objectives was respected, maintaining the anonymity of the personal data of the participants.

RESULTS

The patients with hip fracture seen in the Orthopedic Service were characterized in Table 1. The average age was 77.4 years, the oldest patient seen was 99 years old and the youngest was 59 years old; female sex predominated (60%), most of them were in good cognitive condition (53.3%) and 73.3% were in good general condition at the time of admission.

Table 1. Characterization of hip fracture patients

Patient	Age (years)	Gender	General physical condition of the patient
1	77	Feminine	Good
2	89	Feminine	Good
3	75	Masculine	Good
4	64	Masculine	Regular
5	75	Masculine	Good
6	78	Feminine	Good
7	59	Feminine	Regular
8	97	Feminine	Bad
9	86	Feminine	Good
10	99	Masculine	Good
11	73	Feminine	Good
12	62	Feminine	Regular
13	60	Masculine	Good
14	79	Masculine	Good
15	88	Feminine	Good

Regarding fractures and the use of blood transfusions in the patients seen in the service, the fractures were divided into groups according to the AO International Classification. Four patients were assisted in group 31.A1.1, three in group 31.A1.2, six in group 31.A2.1 and two in group 31.B2.1. The highest percentage was reached by fractures in group 31.A1.2 (33.3%) and the lowest percentage was in group 31.B2.1 (13.3%). The 53.3% had a right hip injury, with an average preoperative hematocrit of 0.34, so it was decided, collectively, not to perform preoperative blood transfusions in 13 of the cases, largely due to surgical planning and religion in two cases. Transoperative blood transfusion was not performed in any of the patients and postoperative blood transfusion was performed in only one. Patient 8, who underwent postoperative blood transfusion, had minimal blood loss during surgery, but his hematocrit was very low and, according to anesthetic criteria, perfusion could have been compromised by anesthesia (Table 2).

Table 2. Characterization of fracture according to the use of transfusions

P	Type of fracture	Member affected	Hematocrit preoperative	Blood T preope-ratory	Blood T transope-ratory	Blood T postope-ratory
1	31.A1.1	Right	0.38	No	No	No
2	31.A1.2	Left	0.40	No	No	No
3	31.A1.1	Left	0.32	No	No	No
4	31.B2.1	Left	0.36	No	No	No
5	31.A1.2	Left	0.34	No	No	No
6	31.A2.1	Right	0.30	No	No	No
7	31.A1.2	Right	0.36	No	No	No
8	31.A2.1	Right	0.26	yes	No	yes
9	31.A1.1	Right	0.41	No	No	No
10	31.A2.1	Right	0.35	No	No	No
11	31.A1.2	Left	0.27	yes	No	No
12	31.A1.1	Left	0.38	No	No	No
13	31.A2.1	Right	0.36	No	No	No
14	31.A1.2	Left	0.30	No	No	No
15	31.B2.1	Right	0.33	No	No	No

P: patient; T: transfusions
Hematocrit-average=0.34

Surgical approaches did not exceed 4.5 cm, mostly 3 cm. Two- or three-hole plates were used, with an 80 cm cephalic screw in more than half of the cases. Trans and postoperative bleeding was very low and in 86.7% of the patients the surgical time was less than 35 minutes (Table 3).

The radiographic evolution in the consultation was good in all cases, with no complications with the use of the technique or with the postoperative evolution. None of the 15 cases included in the study had postoperative complications and loss of fixation, pseudoarthrosis, delayed consolidation and surgical wound infection were ruled out; everyone was alive six months after surgery.

Table 3. Intervention characteristics

Surgical incision size (cm)	**No. of patients**	**%**
2.5	4	26.7
3	6	40
4	3	20
4.5	2	13.3
Number of holes in the sheet		
2	8	53.3
3	6	40
4	1	6.7
Cephalic screw size		
70	1	6.7
75	2	13.2
80	7	46.7
85	3	20
90	1	6.7
95	1	6.7
Trans-operative bleeding		
Very little	13	86.7
Little	2	13.3
Moderate or high	0	0.00
Post-operative bleeding		
None or very little	14	93.3
Little	1	6.7
Moderate	0	0.00
Surgical time		
Less than 35 minutes	13	86.7
From 36 to 45 minutes	2	13.3
More than 45 minutes	0	0.00

DISCUSSION

In the last three decades there has been a significant increase in the incidence of hip fracture, a trend that will continue due to the increase in the number of elderly people, a consequence of longer life expectancy and the impact of existing risk factors in society for individuals over 65 years of age. In 1990, approximately 1.3 million hip fractures occurred worldwide. Current studies estimate that this figure will double by the year 2025 and increase to 6.3 million fractures annually by 2050.[6]

If one were to establish a hypothetical hierarchical order of the objectives of surgical treatment of the elderly patient with hip fracture, the main objective would be to save life, which is achieved in approximately 70% of cases. The second most important objective would be to minimize morbidity; recovery of functional status would therefore occupy a tertiary place, although essential to minimize the psychological impact of the fracture; however, only 50% of these patients achieve a functional status comparable to that prior to the fracture and the loss of functional status after surgery is the most important predictor of depression after a hip fracture. Rapid recovery of functional status is paramount in the management of these patients. As far as surgical treatment is concerned, this

objective can only be achieved by applying techniques that provide the fracture with sufficient stability and that allow early loading.[3,7]

At present, the DHS nail plate is the standard of treatment for stable hip fractures (AO 31.A1); however, it is also used for fractures with more complex fracture traces (AO 31.A2). The use of the cephalo-medullary nail demonstrates that the better the functional results, the lower the rate of complications.[8]

Although the number of cases increased with respect to the previous year and the average age decreased minimally, this fracture is very common in the environment and occurs preferably in elderly patients with a certain degree of physical deterioration.[9] Laffita and collaborators[10] found in their cases that 14.1% (19 patients) had dementia. Hence the importance of minimizing the need for transfusion due to the possibility of risks of erythrocyte and leukocyte-platelet alloimmunization, in particular, and any immunological conflict in general, in addition to preventing possible viral or parasitic transmission from a possible contaminated donor and due to religious conflicts regarding the use of blood.[3] At present, great importance is given to the rational use of blood and its derivatives, and it is a generalized criterion of the related medical and paramedical personnel who make use of its benefits that it is necessary to transfuse better and, logically, to transfuse less.

Hip surgery is considered a high risk of bleeding, it is important to replace blood and to take into account that losses are acute and occur in elderly patients with comorbidities. The proportion of deaths in patients with blood losses over 500 ml is 38.5 and the risks are 2.5 times higher if blood losses exceed 500 ml. Although in this operation it is difficult to quantify bleeding, the influence of this variable on mortality is due to the complications generated by acute anemia.[8]

Minimally invasive surgery with DHS system for intertrochanteric hip fracture is one of the most updated methods in modern traumatology and provides stability in fractures.[10] This procedure is performed with a direct tiny incision and patients tend to have a faster recovery and with less discomfort than traditional stabilization techniques. Several authors have reported in their results the advantages of the technique compared to the traditional procedure: it is an aesthetic procedure that involves minimal bleeding and less postoperative pain and shorter duration of surgery and hospital stay, without sacrificing the stability of the reduction or alignment,[11,12,13] an immediate postoperative period with less pain, mobility is resumed sooner and rehabilitation is less prolonged.[14] The technique is performed using a small set with no additional equipment.

The results obtained in this study are very similar to those reported by other Cuban authors,[8,9,13] but the use of this type of minimal approach is exceptional; however, as reported in this study, complications are few and surgical time is minimal. The longer operative time is related to greater bleeding; many studies[7,14,15,16] report this relationship and even establish that one minute increase in operative time results in 3.2 ml of increase in blood loss. A surgical time of 30 minutes increases the risk of requiring transfusion by 1.8 times. Other studies have shown similar results and have established that the increase in operative time is not only related to greater productivity, but also to a decrease in blood loss and the risk of requiring transfusion.[17,18,19]

Despite the limitations of this study, with a poorly comparative design and a short study period, it is considered that it would contribute to the evaluation of benefits expected by orthopedic surgery specialists who treat fractures of the proximal end of the femur.

CONCLUSIONS

Hip fracture is a frequent condition in the elderly, predominantly in women, who generally present good cognitive conditions and their general condition is good, although the average hematocrit in the preoperative period is low, the use of blood is low thanks to the benefits of osteosynthesis with minimally invasive technique, approaches smaller than 4.5 cm and two or three-hole blades. The use of minimally invasive techniques allows a better evolution of surgically treated patients with hip fractures.

BIBLIOGRAPHIC REFERENCES

1. Delgado Carro R, Martínez Aparicio L, Martínez Aparicio L, Ibañez Zamora E, Martínez Estupiñan LM. Population Aging and Hip Fracture. CMHRJ [Internet]. 2021 [cited 11/12/2021];1(2):38-41. Available at: https://cmhrj.com/index.php/cmhrj/article/view/17/10
2. Martínez Aparicio L, Martínez Aparicio L, Martínez Estupiñan LM, Delgado Carro R, Plain Pazos C, Domínguez Plain L. First Approach to Minimally Invasive Surgery for Hip Fracture - Short Communication. Ame J Surg Clin Case Rep [Internet]. 2021 [cited 11/12/2021];3(2):1-2. Available at: https://www.ajsccr.org/uploads/IMG_143753.pdf
3. Shah FA, Alam W, Ali MA. Intertrochanteric fractures; Frequency of lag screw cut out fixed with dynamic hip screw. Professional Med J [Internet]. 2017 [cited 11/21/2020];24(11):1740-1744. Available at: http://www.theprofesional.com/index.php/tpmj/article/view/634. https://doi.org/10.29309/TPMJ/2017.24.11.634
4. Sizer SC, Cherian JJ, Elmallah R, Pierce TP, Beaver WB, Mont MA. Predicting blood loss in total knee and hip arthroplasty. Orthop Clin North Am [Internet]. 2015 [cited 11/21/2020];46(4):445-459. Available at: https://pubmed.ncbi.nlm.nih.gov/26410634/. https://doi.org/10.1016/j.ocl.2015.06.002
5. Martínez Aparicio L, Martínez Estupiñan LM, Lugo Pijuan LA. Cirugía mínimamente invasiva para la fractura de cadera. Informe de caso. Acta Méd Centro [Internet]. 2021 [cited 11/12/2021];15(2):314-319. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2709-79272021000200314
6. Ramos-Maza E, Chávez-Covarrubias G, García-Estrada F, Buffo-Sequeira I, Domínguez-Barrios C, Meza-Reyes G. Principio biomecánico del sostén. Acta Ortop Mex [Internet]. 2016 [cited 11/21/2020];30(S1):S25-S33. Available at: https://www.medigraphic.com/pdfs/ortope/or-2016/ors161f.pdf
7. Gokulakrishnan PP, Manohara PK, Sakthivel A. Use of Minimal Invasive Technique in Dynamic Hip Screw Fixation. J Minim Invas Orthop. 2017;4(1):e19.
8. Morales Piñeiro S, Morera Estévez L, Morales Morera T, Bretón Espinosa L, Mata Cuevas R, Delgado Carro R. Comorbilidad y mortalidad por fractura de cadera en la región noroeste de Villa Clara. Acta Méd Centro [Internet]. 2019 [cited

11/21/2020];13(3):409-416. Available at: http://revactamedicacentro.sld.cu/index.php/amc/article/view/945/1320

9. Gómez Sarduy A, Morales Piñeiro S, López González MH, Mata Cuevas R. Efectividad de acciones educativas dirigidas a prevenir fracturas de cadera por caídas en adultos mayores. Cuba Salud 2018 [Internet]. La Habana: MINSAP; 2018 [cited 11/21/2020]. Available at: http://convencionsalud2018.sld.cu/index.php/connvencionsalud/2018/paper/view/4
10. Laffita Zamora J, González Pedroso CD, García García E, Pérez Casanova M, Brown Pérez A, Portilla Puente R. Variables perioperatorias que influyen en la morbimortalidad de pacientes operados de fractura de cadera. Rev Cub Med Mil [Internet]. 2017 [cited 11/21/2020];46(4):313-326. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0138-65572017000400002
11. Pountos I, Giannoudis PV. The management of intertrochanteric hip fractures. Orthop Trauma [Internet]. 2016 [cited 11/21/2020];30(2):103-107. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1877132716300239. https://doi.org/10.1016/j.mporth.2016.03.004
12. Méndez-Gil A, Fernández-Valencia Labordea JÁ, Estrada-Masllorensb JM, Plaza-García R, Ríos Martínet M, et al. Técnica DHS mínimamente invasiva: menor tiempo quirúrgico con similares resultados en el postoperatorio inmediato respecto al DHS convencional. Estudio retrospectivo de cohortes. Rev Esp Cir Ortop Traumatol [Internet]. 2014 [cited 11/21/2020];58(6):351-356. Available at: https://www.elsevier.es/es-revista-revista-espanola-cirugia-ortopedica-traumatologia-129-articulo-tecnica-dhs-minimamente-invasiva-menor-S1888441514000745. https://doi.org/10.1016/j.recot.2014.03.005
13. Morales Piñeiro S, Morera Estévez L, Martínez Aparicio L, Cedré González JC, Mata Cuevas R, Gómez Sarduy A. Caracterización epidemiológica de la fractura de cadera. Acta Méd Centro [Internet]. 2020 [cited 11/21/2020];14(2):193-200. Available at: https://www.revactamedicacentro.sld.cu/index.php/amc/article/view/1187/1366
14. Kumar J, Kumar D, Sahito B, Ali M. Minimally Invasive Dynamic Hip Screw for Fixation of Stable Intertrochanteric Fractures of The Femur. JPOA [Internet]. 2015 [cited 11/21/2020];27(1):5-9. Available at: https://jpoa.org.pk/index.php/upload/article/view/228
15. Sanjeev Reddy B, Sanjeevi Bharadwaj. Stable Intertrochanteric Fractures of Femur Treated with Minimally Invasive Sliding Hip Screw Fixation – Outcomes, Pearls and Pitfalls. J Evol Med Dent Sci [Internet]. 2014 [cited 11/21/2020];3(46):11242-11248. Available at: https://www.jemds.com/data_pdf/3_sanjivi%20bharadwaj%20-----shree.pdf. https://doi.org/10.14260/jemds/2014/3466
16. Dhakad RKS, Kapoor A, Gupta S. A comparative study of fixation of fracture intertrochanteric femur with DHS by MIS versus conventional muscle reflection surgical approach. OJMPC [Internet]. 2015 [cited 11/21/2020];21(2):50-56. Available at: https://ojmpc.com/index.php/ojmpc/article/view/13
17. Repantis T, Bouras T, Korovessis P. Comparison of minimally invasive approach versus conventional anterolateral approach for total hip arthroplasty: a randomized controlled trial. Eur J Orthop Surg Traumatol [Internet]. 2015 [cited 11/21/2020];25(1):111-116. Available at: https://pubmed.ncbi.nlm.nih.gov/24557411/. https://doi.org/10.1007/s00590-014-1428-x
18. Suárez Monzón H, Yero Arniella LA, Rodríguez Fernández FR, Águila Tejeda G. Resultados de la atención continuada en el tratamiento de la fractura. Medisur

[Internet]. 2016 [cited 11/21/2020];14(2):173-179. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1727-897X2016000200011
19. Tabares Neyra H, Díaz Quesada JM, Tabares Sáez H, Tabares Sáez L. Actualización sobre prevención y tratamiento de la pérdida de sangre quirúrgica. Rev Cubana Ortop Traumatol [Internet]. 2017 [cited 11/21/2020];31(1):92-109. Available at: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-215X2017000100009

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

CONTRIBUTION OF THE AUTHORS

LMA: conceptualization, formal analysis, research, methodology, data curation, validation, writing the original draft, writing (review and editing).
LMME: formal analysis, supervision, drafting of the original draft, writing (proofreading and editing).
LMA: formal analysis, validation.
SMP, LALP: data curation, validation, writing the original draft, writing (proofreading and editing).