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Osteosynthesis errors in intertrochanteric fractures were treated with the DHS system. A single-center observational study.

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Abstract

Introduction: The use of the sliding plate/screw system for intertrochanteric fractures has proven to be a very effective fixation method, but it is still not free from failures. The objective of the study was to evaluate the causes of failure of the osteosynthesis system in patients who suffered intertrochanteric fractures who underwent surgery with the DHS sliding plate/screw system, pointing out the technical defects in its placement.

Methods: The present observational study was conducted at the Teodoro Maldonado Carbo Hospital in Guayaquil from September to December 2022. Patients with intertrochanteric fractures who underwent surgical reduction with the DHS system were evaluated. The position of the cephalic screw in the femoral head and complications were measured. The odds ratio was used to measure risk.

Results: Seventy-three cases were included, including 45 women (61.6%), with an average age of 82 years. The failure rate was 1.36% (95% CI -1.3%, 4.04%). The position of the head screw in the central – anterior zone was 23 cases (31.5%) OR=0.70 (0.03-17.9) P=0.83, central – central zone was 20 cases (27.39%) OR=0.85 (0.03-21.8) P= 0.92, inferior – anterior zone was 18 cases (24.65%) OR=0.98 (0.04-25.2) P=0.99, posterior – inferior zone was 11 cases (15.06%) OR=1.78 (0.07-46.5) P=0.73, and superior – posterior zone was 1 case (1.36%) OR=145 (4.02-5232) P=0.007.

Conclusions: The superior-posterior positioning of the cephalic screw can increase the possibility of migration and, therefore, the system failure rate.

Keywords:

MeSH: Hip Fractures; Femur Head; Fractures, Bone; Postoperative Complications; Aftercare.

Abbreviations

Not declared.

Supplementary information

No supplementary materials are declared.

Thanks

Not declared.

Author contributions

Carlos Xavier Moyano Macias: Conceptualization, data curation, formal analysis, acquisition of funds, research, writing - original draft.
Felipe Fernando Jimenez Pinto: Conceptualization, Data curation, Formal analysis, Methodology, Resources, Supervision, Validation, Visualization, Writing – review and editing.
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Availability of data and materials

Not declared.

Surgery

Introduction

Hip fractures are considered the new orthopedic epidemic today, as they are the most common cause of hospitalization in traumatology services globally. The considerable increase in its incidence and the variety of economic and social repercussions imply significant challenges for health service professionals [1]. In the United States, the annual incidence of hip fractures was 250,000 in the last decade, and it is estimated that by 2040, that number will reach 500,000 [2]. At the Teodoro Maldonado Hospital in the city of Guayaquil, 40% of patients admitted to the traumatology service presented with hip fractures, primarily intertrochanteric. The purpose of the study will be to evaluate the causes of failure in patients with intertrochanteric fractures treated with a sliding plate/screw, pointing out the technical defects in their placement.

The use of dynamic hip screw (DHS) systems for intertrochanteric fractures became popular in the 1970s and, over the years, has proven to be an effective fixation method, acting as a lateral tension band on the femur, which allows forces to be transmitted to the medial cortex, facilitating the impaction of the fracture. However, this system is not free of complications [3]. In 2019, the Argentine Association of Orthopedics and Traumatology published a study of 177 patients who suffered an intertrochanteric fracture, obtaining a system failure rate of 8.4%.

Intertrochanteric fractures tend to occur mostly in elderly patients, and the DHS system is an excellent treatment choice for these fractures. The central topic to study will be the osteosynthesis errors that may occur when treated with the DHS system; data that to date are not counted in the city of Guayaquil, where the study is carried out; for this reason, its value increases since it will remain as a scientific contribution to the community of researchers who deal with the topic in the future. Given this approach, the following research question was posed: What are the primary technical defects found and the complications in patients operated on with the DHS system admitted as an emergency with an intertrochanteric fracture between September and December 2022 at the HTMC? The objective of the present study was to determine, through direct observation, the functional results and possible complications that may arise after surgical treatment with the DHS system in intertrochanteric fractures.

Materials and methods

Study design

The present study is observational and cross-sectional. The source is prospective.

Scenery

The study was conducted in the Traumatology Service of the Teodoro Maldonado Carbo Hospital of the Ecuadorian Institute of Social Security in Guayaquil, Ecuador. The study period was from September 1, 2022, to December 31, 2023.

Participants

Adult patients over 60 years of age with a diagnosis of intertrochanteric hip fracture who received surgical treatment with the DHS system were included. Patients whose follow-up was not completed for six months in the postoperative period were excluded. Patients with pathological fractures were also excluded.

Variables

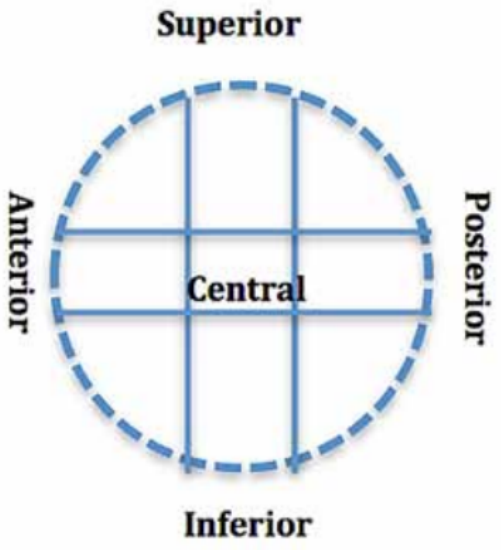
The variables were demographic data, the presence of adequate postoperative reduction, and screw position.

Data sources/measurements

The source was direct; an electronic form was filled out using data from postoperative control radiographs. Adequate postoperative reduction was considered when the angle formed by drawing a line through the femoral diaphyseal axis and another through the neck axis (cervical-diaphyseal angle) was between 127° and 135°, as measured with a goniometer. The tip-to-vertex distance (DPV) was measured in mm.

The position of the cephalic screw was analyzed by dividing the femoral head into nine zones with the anteroposterior and lateral radiographs (upper, central, and lower thirds in the ap projection and the lateral projection; it was divided into anterior, central, and posterior) (Figure 1).

Figure 1. Distribution of zones in the femoral head.



The following quantitative variables were obtained:

- Cervical-diaphyseal angle: <127° (varus reduction) and from 127° to 135°
- Tip to vertex distance (DPV): <25 mm or >25 mm

The following qualitative variable is used:

- Position of the cephalic screw: center-center, center-anterior, center-posterior, center-inferior, center-superior, antero-superior, antero-inferior, postero-superior, postero-inferior.

After a multivariate analysis and comparison with the control radiographs taken for at least six months, we will be able to obtain whether or not there were complications after surgery and what they were (cephalic or medial migration of the sliding screw (cut-out/cut-through), loss of fixation, pseudoarthrosis, disengagement of the plate with the femoral shaft (pull-out)).

The data were obtained by reviewing medical records found in the database (AS400) of the Teodoro Maldonado Carbo Hospital and the TELEPAC program to review pre- and postsurgical images. The information was confidential; no personal data were included to identify the study subjects.

Biases

To avoid interviewer, information, and memory biases, the leading researcher always maintained the data with a guide and records approved in the research protocol. Observation and selection bias was avoided by applying participant selection criteria. Two researchers independently analyzed each record in duplicate, and the variables were registered in the database once their agreement was verified.

Study size

The sample was probabilistic. Guayas-Ecuador has 4,391,923 inhabitants. The percentage of older adults was 9.0% in 2022, according to INEC, which represents 395,273 older adults. It is estimated that 1% of adults over 65 years of age will have hip fractures, which corresponds to 3952 possible cases as a whole. Using the EPI info ™ program (Version 7.2.5, CDC, Atlanta, USA, September 2022.) with an expected frequency of 7.0%, a confidence limit of 5%, a 90% confidence interval, and a sample size of 69 cases.

Quantitative variables

Descriptive and inferential statistics were used. The results of categorical variables are expressed as frequencies and percentages. Scale variables are defined as the mean and standard deviation.

Statistical analysis

Noninferential statistics were used for descriptive analysis, and a 95% confidence interval was used to describe the error rate in osteosynthesis. In the inferential analysis, the measurement of stratified risk factors is used, using the five initial positions of the screw in the femoral head to predict the outcome of osteosynthesis error. Using chi-square tests, the results are presented as odds ratios, 95% confidence intervals, and *P* values.

Results

Participants

The study included 73 patients; 11 cases were excluded, nine due to incomplete data and two due to pathological fractures.

Description of the study group

There were 73 cases. The sample included 45 women (61.6%) and 28 men (38.4%). The average age was 82 years (range 60-90 years).

There were no cases of inadequate reduction in varus. Regarding the placement of the cephalic screw, the area with the highest frequency of placement was central – anterior with 31.5% in 23 patients, also obtaining the following positions: central – central with 27.39% in 20 patients, inferior – anterior with 24.65% in 18 patients, posterior – inferior with 15.06% in 11 patients and superior – posterior with 1.36% occurring in 1 patient.

DHS failure rate

The failure rate was 1.36% (1 patient), and the 95% confidence interval for a proportion was (-1.3%, 4.04%). The complication occurred with loosening with cephalic migration (cut-out) of the proximal screw. The original position of the screw was superior–posterior, with a (DPV) >25 mm. During follow-up, this patient suffered from migration of the cephalic screw (Figure 2).

Table 1 . DHS screw position description.

Screw position	N=73
Central-anterior	23 (31.5%)
Central-central	20 (27.39%)
Inferior-anterior	18 (24.65%)
Posterior-inferior	11 (15.06%)
Upper-posterior	1 (1.36%)

Risk analysis

The risk of error in osteosynthesis was analyzed according to the position of the screw, in which the superior-posterior location was statistically associated with error in osteosynthesis. Odds ratio of 150 ($P < 0.01$). No statistically significant relationship was evident with other screw positions, with all the remaining positions having a successful result (Table 2).

Table 2. The risk of malfunction depends on the position of the DHS screw.

Screw position	Odds Ratio (CI95%)	*Q*
Central-anterior	0.7021 (0.0276-17.89)	0.8305
Central-central	0.8537 (0.0334-21.82)	0.9238
Inferior-anterior	0.9820 (0.0383-25.17)	0.9912
Posterior-inferior	1.7826 (0.0683-46.53)	0.7283
Upper-posterior	145 (4.02-5232)	0.0065

Discussion

As indicated in this study, the DHS system is indicated for stable intertrochanteric fractures. However, it usually presents complications, according to a study published in 2019 by the Argentine Association of Orthopedics and Traumatology carried out at the British Hospital of Buenos Aires. From a total of 143 patients, a failure rate of 8.4% was obtained, with seven patients presenting cephalic migration of the proximal screw, two patients presenting medial migration, two presenting pseudoarthrosis, and one presenting inadequate reduction in varus. A total of 7.7% of their patients ended up with a second operation, and the worst position was the superior/posterior position of the head screw, presenting 100% migration. A study carried out in 2001 by Kim et al. found a failure rate of 10-16% in unstable fractures [6]. The literature indicates an acceptable value between 6.8% and 16% for the osteosynthesis failure rate in patients with intertrochanteric fractures operated on with the DHS system [7, 8].

Although there is abundant evidence that supports that the VPD and the position of the cephalic screw are essential elements to take into account as predictive factors, there are others, such as the patient's age, type of fracture, reduction and bone quality, that also affect the results. Given these data, our failure rate remains below the average in the literature.

As strengths of our study, we highlight that all patients were operated on in the same hospital using the same surgical technique and that the number of patients was adequate to establish a statistical relationship.

The limitations were those of a retrospective study. Measurements were performed manually with a goniometer, which could involve precision bias.

Figure 2. Control X-ray one month after surgery.

In this study, the most significant number of patients with intertrochanteric fractures were women. Adequate clinical management before surgical intervention is very important due to the high rate of comorbidities that older adult patients may present.

The DHS system is handy, and over time, its technique has been refined, making it an efficient tool for intertrochanteric fractures. According to the results obtained, this system is the most suitable alternative for treating intertrochanteric fractures.

Although the percentage of patients who had an osteosynthesis error (loosening + migration of the cephalic screw) was low, it is essential to mention that it is a real complication and occurred in a lower percentage than indicated in the literature, thus evidencing the preparation and skill of the

personnel that make up the Traumatology and Orthopedics service of the Teodoro Maldonado Carbo Hospital.

The analysis of our study allowed us to conclude that the superior/posterior positioning of the cephalic screw could increase the possibility of migration and, therefore, the system failure rate.

We understand that, currently, this system is reserved for stable intertrochanteric fractures, in which an adequate reduction, the correct positioning of the cephalic screw, and a VPD <25 mm are essential for a good evolution, although no precise studies have been found that rule out the use of this osteosynthesis system in unstable intertrochanteric fractures, as happened in the present study.

Conclusions

The positioning of the screw in the superior-posterior radiological zone of the femoral head was a risk factor for the presence of osteosynthesis error in this study group of older adults in a 6-month regimen.

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Statements

Ethics committee approval and consent to participate

The ethics committee of the Faculty of Medicine of the University of Guayaquil approved the study.

Publication consent

Not needed when patient-specific images, X-rays, and studies are not published.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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