Orientation of the acetabular cup after total hip arthroplasty. A retrospective study

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Background
Introduction: Total hip arthroplasty (THA) is one of the most frequently performed surgeries worldwide, with high satisfaction rates. However, the orientation of the acetabular component in THA has a direct impact on the risk of dislocation in 2 -3%, the safety zone of 15° anteversion / 45° inclination is described, and these radiographic measurements use the Widmer method. Methods: It is a retrospective study, from the period January 2022 to July 2023, all patients treated with THA at Hospital General Xoco in Mexico City were included. The measurement in degrees of anteversion and inclination was carried out with the Widmer method on postoperative radiographs using the CareStream medical imaging system. Results: 89 patients were studied, 62 women and 27 men, average age of 63±1.7 years, the following data were obtained: the mean inclination averaged 42±1.6°, and anteversion with an angulation of 14.5±1.3°; The diagnosis for which they presented were primary osteoarthrosis in 52.8% of the patients, sequelae of dysplasia in the development of the hip in 13.4% and intracapsular fracture in 33.8%, when discriminating by group inside and outside the Lewinnek safe zone n = 60 and 29 respectively. No episode of dislocation was recorded in our population. Conclusion: In our population, the conventional technique for THA, without the use of navigation systems or support of imaging studies, reported anteversion and inclination figures within the safety parameters.

Keywords: Acetabular orientation, total hip arthroplasty, measurement, lewinnek

Total hip arthroplasty (THA) is one of the most performed surgical procedures worldwide, as a treatment for degenerative, traumatic conditions and sequelae that affect the hip joint (1-2), it is one of the most reliable procedures; safe and successful in orthopedic surgery, with high levels of satisfaction, with improvement in pain, function, and rapid adaptation to activities of daily living (3). There are numerous implants, each with different technologies and multiple indications according to the anatomical and functional requirements of the patient. The survival of these implants ranges from 90% at 15 years and 70% at 20 years (4). By 2030, this procedure will be performed above half a million per year, only in North America (5).

The anatomical and functional system of the hip is formed by bone structures and ligaments, conditioning the morphology of this joint to preserve a balance during standing and walking, processes that alter this structural balance result in deformities with repercussions on function and degeneration (6, 7, 14). The orientation of the acetabular component of the implant after THA has a direct impact on the risk of dislocation and wear of the polyethylene, therefore presurgical planning with imaging studies is essential for decision-making. On the other hand, after THA, there are different methods to evaluate the anteversion and inclination of the acetabular component to make a prognosis of the prosthesis (8). Widmer's method uses a formula, where it performs an inverse calculation of a function where anteversion is equal to the division of the short axis by the total axis of the cup (9, 10), it is a reproducible method, easy to use where Only an anteroposterior radiograph of the pelvis with adequate technique is required (11, 12). Lewinnek (1978) described the limits of the position of the acetabular component with cup inclination and anteversion of 40° ± 10° and 15° ± 10°, respectively, representing a Lewinnek “safe zone” (LSZ), which minimizes dislocation after primary THA (13, 14), the most frequent condition that is associated with the orientation of the components is hip dislocation in 2-3% in the first postoperative weeks and gradually decreasing as to the implant survival time (15).

Recent reports with different methods of analysis of the location of the acetabular cup have reported different figures than those described by Lewinnek (13, 14, 22). Murphy and You (2018) conclude that the LSZ currently cannot be used as a predictor. of instability (23, 24), similar works add to

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Sex	LZS	X^2	*p*
Male	23	5.57	0.02
Female	37		

Table 1. Distribution by sex.

the above studies of computed axial tomography where an axial cut adds the version of the femoral component, which would be taken as another variable to postulate a risk of dislocation (25, 26, 27), Recently, the spinopelvic balance has gained popularity as an added value to THA, taking into consideration the relationship between the lumbosacral spine and the center of rotation of the femoral head, to evaluate the nutation and counter-nutation movements for the prosthetic stability (28, 29).

Finally, surgical support with three-dimensional navigation has become a reliable instrument to avoid the margin of error when placing prosthetic implants in THA procedures (30, 31). However, comparative studies between navigated surgery and the use of fluoroscopy have not yielded significant results (32), different studies conclude that the surgeon's experience, skill, and technique have a direct impact without referring to the superiority of assisted hip surgery (33). The objective of this study was to measure the cup orientation angles in a group of post-surgical patients where no type of intraoperative assistance was used.

Methods

This is a retrospective and cross-sectional study where a series of cases (N=86) were analyzed, included in a period of time from January 1, 2022, to July 31, 2023, including all patients treated for the first time, with THA at the Hospital General formula consists of performing an inverse calculation of the sine of an angle where; [anteversion=arcsin(short axis / long axis)], subsequently the inclination of the component is obtained in degrees, taking into consideration a horizontal line based on both tears of the acetabular bottom (9, 10), the relationship between these values provides us the anteversion of the acetabular component, being a reproducible method, easy and quick to use, where only an anteroposterior radiograph of the pelvis with adequate technique is required (11, 12).

Statistical analysis, Statistical calculations of normality were carried out, frequencies and percentages were obtained for the qualitative variables, measures of central tendency were obtained for quantitative variables, the evaluation of results was carried out using the Chi2 function, and $p < 0.05$ was taken as significant. IBM SPSS v.23 statistical package was used.

Etiology	LZS	X2	P
Hip osteoarthrosis	29	1.48	0.26
Hip dysplasia	6	1.91	0.19
Hip fracture	25	5.21	0.03

Table 2. Comparison of qualitative variables by etiology.

Results

In this study, 89 patients were included, of which 62 were female and 27 were male, with a mean age of 63 years (SD 13.5 95% CI 60.3-64.7), the same number of postoperative radiographs were evaluated, the following were obtained: data: the mean inclination was 42° (SD 8.1 95% CI 40.3-43.6), the anteversion was 14.5° (SD 9.11 95% CI 12.1-15.8), the population was divided into 2 groups, those that presented an orientation acetabular within the LSZ and those without, with the following frequencies n= 60 and 29 respectively, when comparing orientation with sex, statistically significant differences were obtained, shown in table 1.

The diagnosis of THA surgery was distributed as follows: primary osteoarthrosis 47 (52.8%), sequelae of dysplasia in the development of the hip 12 (13.4%) and intracapsular fracture 30 (33.7%), variations associated with the LSZ showed significant differences in patients with a history of intracapsular fracture (p=0.03), table 2.

It was decided to discriminate the population into 2 groups by age, in the group under 60 years of age there was a frequency within LSZ of 25 vs 10 and over this age 35 vs 19 without statistically significant differences, at the time when the x-rays were measured, in No episode of dislocation was recorded in our population.

Discussion

THA is currently a safe and effective surgical procedure for the treatment of degenerative or traumatic pathologies of the hip, with high long-term satisfaction rates and high levels of survival over 20 years (1, 2, 3, 4, 5).

The orientation of the acetabular component is a widely studied topic; different methods have been used throughout the international literature (8, 10, 11, 12); in this study, we chose to use the Widmer method, due to its reproducibility and ease of use. application through measurements and mathematical calculations (9), the population studied is similar to previously published case series, with similar demographic characteristics (6, 14, 19, 21, 25, 30, 33), the type of approach used was direct lateral of Hardinge and

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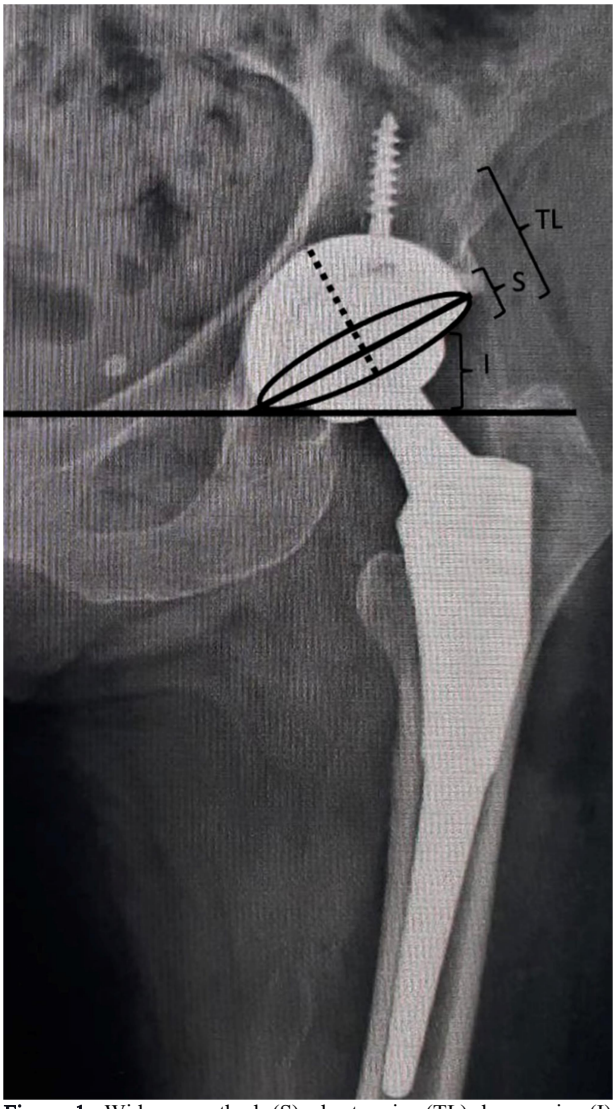

Figure 1. Widmer method (S) short axis, (TL) long axis, (I) Inclination.

previous without, however, no representative statistical differences have been reported granting superiority of one approach over another (16), obesity was not a variable taken into account by the methodological design despite the fact that a close association has been found between the BMI, in addition to sex and placement technique (17, 18, 19, 20, 21), Deep and Prahakara report ranges of inclination 42 – 55 and anteversion 6 – 14, describing that the female group presented a greater degree of anteversion, suggesting a value higher than that reported by Lewinnek (>15°) similar to our population, combining anatomical studies in Mexican women that report acetabulums with greater anteversion compared to other populations (19, 20).

Degrees of inclination and anteversion similar to those reported in other populations were obtained: 42° (SD 8.1 95% CI 40.3-43.6) and 14.5° (SD 9.11 95% CI 12.1-15.8) respectively (6, 8, 9, 10, 14, 19, 21, 25, 30, 33), radiographic analysis is mandatory for every orthopedic surgeon; in the case of the hip, measurements to define the orientation of the acetabular component have been studied as a predictor of different complications (15, 16).

Currently, talking about the orientation of the acetabular component as proposed by Lewinnek (13) is under discussion, since a series of studies have found figures different from those reported without instability data (23, 24, 25); Adding elements such as CT for the axial plane and assessing the importance of femoral anteversion and the sum of both measurements (22, 26, 27, 30, 31), the anteversion and inclination means already described are within the values reported by Lewinnek Although at this time with the rise of robotic surgery, studies have tried to equate post-surgical results of surgeries using fluoroscopy and assisted by navigation, however, superiority over the conventional technique has not been demonstrated (32, 33); This study has the limitation of having only one imaging study (anteroposterior radiography of the pelvis), ignoring femoral anteversion. In addition to being a cross-sectional study, the identification of other variables is excluded due to the methodological design.

Conclusion

In our population, the conventional technique for THA, without the use of navigation systems or support of imaging studies, reported anteversion and inclination figures within the safety parameters. The present investigation creates a database for monitoring; prospective and comparative studies are suggested to obtain results with greater statistical weight.

Conflicts of interests

The authors declare no conflict of interest.

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