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Research Article

Collum Femoris-Preserving Hip Stem: Clinical and Radiographical Results from a Medium-Term, Multi-Centric Study in a Latin American Population

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Abstract

Background: There is a lack of information related to the medium-term results of short stem prosthesis in the Latin-American population. This study represents the longest follow-up results of the CFP prosthesis in the Latin-American population.

Methods: Two-hundred fifty-five patients treated with anatomic neck preserving from June 2013 to June 2020 were enrolled in the current study. The mean follow-up was 81 (60-96) months. All the subjects were available for the follow-up examination at a minimum of 5 years after surgery. Clinical results were assessed using Oxford Hip Score (OHS). Radiologic assessment was performed at each follow-up.

Results: Follow-up was 81 (60-96) months. Two-hundred fifty-five patients were contacted. The patients with hip dysplasia were operated with the CFP stem in 10.2% of all cases; with regards to the Dorr classification of the proximal femur, type 1: 9.8%; type 2: 88.6% and type 3: 1.6%. The overall prosthesis survival was 96.1%. The functional results were OHS pre: 9.1 (3-35), post: 44.4 (27-48).

Conclusion: The surgeries with CFP stem have excellent clinical results. The main indication of this short stem is primary hip osteoarthritis; nevertheless, we have some experience in dysplastic hips with good clinical results and survivorship. The results are comparable in terms of survivorship when this stem is implanted in Dorr 1, 2 and 3; however, we had a limitation, the sample was not comparable in the three groups. The overall survivorship, the functional scales and the radiographical results in the Latin-American population are comparable with literature reported around the world.

Level of Evidence: Level III

***Keywords:** Hip, Prosthesis, Radiographical, Clinical.*

Introduction

For several years, hip pain secondary to osteoarthritis has been treated very successfully with the procedure called the surgery of the 20th century: total hip joint replacement.[1] Since the 19th century, several strategies have been developed to try to replace this joint.[2] These techniques included the use of interposition soft tissues such as the fascia lata, the skin or the pig's bladder and the covering cup of the head femoral, described by Smith-Peterson in 1938.[3] Then, Wiles develops the first total hip prosthesis in 1938,[4] design that received different changes and modifications without achieving the best results in terms of durability and functionality in the patients. Therefore, Sir John Charnley was responsible for a drastic impact on the development of low-friction implants.[5]

Development that has been one of the three pillars of proper functioning of the hip prosthesis: low friction, cement as a method of fixing the implant to the bone, and high-density polyethylene. Despite all this and the success of this surgery, problems such as bone resorption associated with the femoral stem persist, and this is the main reason why short stems have come onto the market.[6–11] This type of stem has been indicated in young, highly functional patients and in those where the aim is to preserve the bone reserves of the femoral neck as much as possible.[12–17] Therefore, various designs: short and ultra-short have tried to meet these requirements. The CFP (Collum Femoris Preserving) was introduced by Pipino in 1978. They reported excellent results.[5,18] Nevertheless, one of the relative contraindications are femoral necks with dysplasia, in this work we intend to show that the clinical results are good or excellent, when total hip arthroplasty (THA) with short stems is performing in Latin American population (that has a large percentage of osteoarthritis associated with femoral necks with dysplasia). Also, we describe the survival and causes of failure of these short stem implants.

Materials and Methods

Study Design and Ethical considerations

We conducted an observational analytical cohort study that did not need a patient consent. IRB approval was obtained from our institution (IRB00007736 minutes No. 41-2021).

Patient Selection

Between 2013 and 2017, two-hundred fifty-five THA were performed with the anatomic neck preserving LINK® C.F.P.® stem (Waldemar Link, Hamburg, Germany). Plain radiographs were evaluated pre and postoperatively. It was determined whether the patients had hip dysplasia and the bone quality of the proximal femur was identified with the Dorr classification.

Surgical Procedures

The patients receive a pre-operative surgery guide named “hip surgery manual”. Selected antibiotic and one gram of tranexamic acid are administered in the prep room, between 60 to 30 minutes before the incision. The patient is placed supine. A Watson Jones approach is performed. We make a hole with a punch in the center of the neck and then with a curved curette that accompanies the instruments, we proceed to permeabilize the neck up to the metaphysis. Then, the dilators are passed to continue with the femoral rasps. The rasp is inserted and proceed to carry out the acetabular preparation. The joint is dissected; a Hohmann-type hip retractor at the anterior border, a Müller-type retractor at the posterior border, and a blunt retractor medial at the transverse ligament is placed. The remains of the labrum, the lateral and medial osteophytes are removed. The posterior osteophyte is removed after placing the acetabular cup. Drilling is initially performed medial to the quadrilateral lamina and then we proceed to deepen the roof. The size of the cup will be defined when we have bleeding at the subchondral bone. The double mobility cups are inserted deeper than conventional cups to avoid protrusion of the metallic edge and lesions to the psoas muscle. The holes in the cup are used to verify a correct deepening of the cup. A previous measurement of the depth is carried out in cups with double mobility or those that do not have holes. As previously mentioned, the posterior osteophyte is removed before placing the polyethylene to avoid damage to it during this step. The femur is exposed again and a test with the rasp is carried out to define length and stability. The final femur is positioned, and the stability and length of the extremities are tested. The final head is placed with caution once the stem cone is completely dry. The joint is reduced and washed with iodine solution, verifying hemostasis and that there is no residue in the joint. Finally, it is closed by planes. Negative pressure systems are used in the case of previous scars or abundant fat pad.

Evaluation

Survivorship was calculated using the Kaplan-Meier method.[19] Patients who were lost to follow-up were censored.

Clinical Assessment and Functional Scales

Clinical outcome was evaluated using the Oxford Hip score (OHS). These three PROMs met the Consensus- based Standards for the selection of health Measurement Instruments (COSMIN) standard for recommendation of use for assessing THA outcomes in the three main evaluation areas: pain, function, and quality of life.

Statistical analysis

The calculation of the sample size in this descriptive study seeks to make inferences according to a proportion of the population. Taking the prosthesis survival rate at 7 years as the outcome of primary interest, registering 179 patients with this follow-up time would allow, with a reference proportion of 85%, an accuracy of 11% with a statistical power of 85%, at a 5% alpha level of significance. If a loss of approximately 30% of the cases is assumed after 5 years of the implantation of the prosthesis, it would be necessary to identify 255 patients in whom the stem has been implanted. Qualitative variables were described with frequencies and proportions. Quantitative variables were described in terms of mean with interquartile ranges. Because the statistical distribution of the clinical evaluations was non-gaussian (tested by Shapiro-Wilk test), non-parametric tests (Wilcoxon matched-pairs signed-rank test) were used to compare the pre- and postoperative surgical evaluations. The time elapsed between the date of surgery and the date of failure or the date of the last clinical control were used to calculate the implant survival probability, assessed using the Kaplan-Meier product-limit estimates[19]. The Log-rank or Wilcoxon tests were used to test the statistical significance of the observed differences. All tests were 2-tailed. The data were processed in the IBM SPSS program version 14.0 (SPSS Inc., Chicago, Illinois). A significant P value of less than 0.05 was considered significant.

Results

After a mean follow-up of 81 (60-96) months, 246 patients were available for follow-up. The surgeries were made in two in the period between 2013 and 2020. The mean age was 62.7 (36-85). There were operated 57.3% of right hips and 42.7% of left hips. Of all surgeries, the slight stem curve was predominantly used (77.6%). The size of the stem was: XS: 32.9%, S: 49.4%, M: 16.8% and L: 0.7% (Table 1).

Table 1: Demographic data

Parameter	Value
Sex	Male: 28.6%; Female: 71.4%
BMI	23.9 (20-38.7)
Dysplastic Hip	Yes: 10.2%; No: 89.8%
Dorr	1: 9.8%; 2: 88.6%; 3: 1.6%
Stem curve	Slight: 77.6%; Strong: 22.4%
Postoperative stem alignment	Neutral: 96.1%; Varus: 3.9%
Radiolucent lines	Yes: 3.1% ; No: 96.9%

BMI, Body Mass Index
* Mean, interquartile ranges

Clinical Analysis

PROMs showed a statistically significant improvement after THA. All the preoperative subjects of the scales were classified as poor OHS: 9.1 (3-35), whereas the postoperative was excellent 44.4 (27-48) (Table 2).

Table 2: Patient- reported outcome measures (PROMs)

Functional tests	Preoperative	Postoperative	p
OHS*	9.1 (3-35)	44.4 (27-48)	<0,001

OHS, Oxford Hip Score
* Mean, interquartile ranges

Complications

One patient (0.4%) had a superficial wound infection that was treated with antibiotics. The stem did not loosen at the time of final follow-up (Table 3).

Table 3: Complications and Treatments

Patient No.	Complication	Treatment	Date of Complication
12	Superficial wound infection	Antibiotic treatment	2013

Radiographic Analysis

The radiographs of all patients were analyzed after a mean follow-up of 81 (60-96) months. Eight patients (3.1%) had progressive radiolucent lines of 2 mm around 1 and 2 Gruen zones; all these cases required revision surgery.

Implant Survivorship

Survival analysis was performed with a minimum follow-up time of five years and a maximum follow-up time of 7 years; therefore, survival was evaluated on average during this time interval. The overall survivorship at a mean of 81 (60-96) months of follow-up was 96.1%, the estimate was 95.3, the typical error was 0.731 and, with a confidence interval of 95%, the inferior and superior limit was 93.9 and 96.7, respectively (Fig. 3). A failure was defined as a revision of the prosthesis. Nine patients required revision of the prosthesis. The causes of the revisions were aseptic loosening (2%), septic loosening (1,2%) and periprosthetic femur fracture (0.4%) (Table 4). The survivorship analysis was developed with the Kaplan-Meier method. The implant survivorship was the final event, two-hundred fifty-five patients were included in the analysis. One patient died during the follow-up. The death was secondary to factors unrelated to the prosthesis. A comparative analysis of the survivorship was done in patients < 50 years and > 50 years, sex (male versus female), BMI (Body mass index (<25 versus >25), based on the preoperative diagnosis (dysplastic hip or not), the proximal femur anatomy (Dorr classification), stem curve (slight versus strong) and postoperative stem alignment (neutral versus varus). Nevertheless, there was no difference in terms of survivorship.

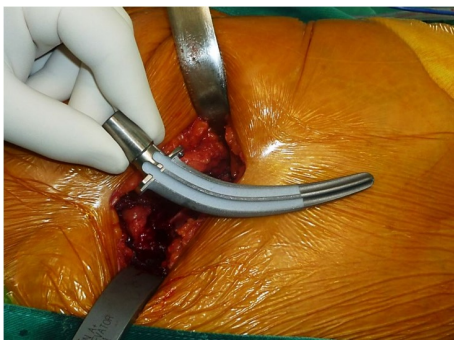

Figure 1. *"In vivo" CFP stem.*

Figure 2. *AP view of the CFP prosthesis implanted in the right hip*.*

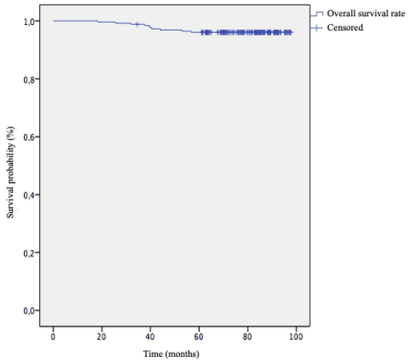

Figure 3. *Kaplan-Meier graph illustrating overall survivorship for the entire cohort. Patients who were lost to follow-up were censored. Survivorship at 7 year is 96.1%.*

TABLE 4: Causes of Failure and Treatments			
Patient No.	**Cause of Failure**	**Treatment**	**Date of Failure**
9	Aseptic loosening	Revision	2016
12	Aseptic loosening	Revision	2015
30	Septic loosening	Revision	2016
61	Aseptic loosening	Revision	2017
67	Septic loosening	Revision	2017
70	Periprosthetic Femur Fracture	Revision	2015
81	Aseptic loosening	Revision	2017
87	Septic loosening	Revision	2017
93	Aseptic loosening	Revision	2018

Discussion

THA is named the surgery of the 20th century. Improved design is the reason for its success. The neck is the former structure of the proximal femur designed to spread the stresses both in compression and tension towards the metaphysis and the greater trochanter. Therefore, femoral neck preserving in total hip arthroplasty allows an optimized stresses' distribution to obtain both an optimal integration and a subsequent better bone remodeling.[8,9,20] Previous studies related to survival and the rate of complications of this type of femoral neck-sparing prosthesis have been carried out, showing promising results after an 11-year follow-up[18]. However, studies of isolated survival, causes of revision and failure rates of the femoral stem have not been performed in the Latin American population. The survival of this type of prosthesis rises to 95.7% in the study carried out by Kendoff et al in 2013. Other studies have published survival rates that vary from 85% to 97%. Ender et al reported on the clinical results of another cementless femoral neck prosthesis (CUT) with a survival rate of 89% after 5 years.[21,22] Klein et al published the 2-year results of a CFP compared with Corail stem; 2 CFP stems were revised due to loosening and none of the Corail stems was revised.[2] A survival rate of 97% using an ultrashort non-anatomic cementless stem in 280 patients was also reported in a prospective study by Kim et al.[14] However, the weakness of this study is that was not randomized and there has no control group to compare the results obtained. The CFP (Collum Femoris Preserving) prosthesis was introduced by Pipino in 1978 for younger patients and patients with adequate bone stock.[5,23] Floerkemeier et al reported successful outcomes from patients with osteonecrosis of the femoral head treated with a CFP prosthesis.[24] Pipino et al reported the first long-term results in 44 short-stem CFP prostheses with a follow-up time of 13 to 17 years.[23] The reported clinical results, however, were excellent or good only in 82% and the survival rate was relatively low at 80%. Another study by Pipino et al, with the largest cohort of 368 patients (390 hips), utilizing the CFP prosthesis with a lateral approach demonstrated an improved HHS to over 90 in 82% of this study cohort.[5] In our study, we used the OHS scale ("Oxford Hip Score") to demonstrate that the PROMs found in our Latin American patients are comparable to those reported in the world literature. Additionally, regarding complication rates, our study is comparable with respect to surgical site infection, peri-prosthetic infection, aseptic loosening, and varus displacement of the femoral stem. We did not have intraoperative femoral fractures or dislocation of the stem. No intraoperative complications were observed in the cohort of patients included in the current study. Therefore, short stems are a very good option in the Latin American population. We have phenotypic characteristics, such as height, the shape of the proximal femur, and a considerable number of people with dysplastic femoral necks that can fits with short stems designs.

Limitations and Future Perspectives

This is an observational study in a population where the world does not know the demographic, functional and survivorship results of a specific surgery and implant. This has statistical limitations, like a homogeneous sample, the lack of a comparative group and randomization. Therefore, prospective comparative randomized studies are needed. The comparison could be done with the evolution of the "CFP", the "CFP II", but previously we need to report the results that we had get with "CFP II". We also may get the results of the different types of short stems that we have in our Latin American countries and stablish the differences.

Conclusions

The surgeries with CFP stem have excellent clinical results in terms of PROMs. The main indication of this short stem is primary hip osteoarthritis; nevertheless, we have some experience in dysplastic hips with good clinical results and survivorship. The results are comparable in terms of survivorship when this stem is implanted in Dorr 1, 2 and 3; however, we had a limitation, the sample was not comparable in the three groups. The overall survivorship, the functional scales and the radiographical results in the Latin-American population are comparable with literature reported around the world.

Conflict of Interest

The authors have no conflict of interest to declare.

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