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Comparative analysis between plate and cannulated screw in fracture of the posterior malleolus: a retrospective observational cross-sectional study

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Abstract

Introduction: Ankle fractures account for approximately 4% of all fractures, with an annual incidence of 124 in 100,000 people in the United Kingdom. More than a third of these contain involvement of the posterior malleolus. **Objective:** It was to analyze and compare the anteroposterior screw (PAS) and posterior support plate (PSP) techniques in postoperative results and percentage of complications, comparing radiographic and functional results in the surgical treatment of the posterior malleolus. **Methods:** The present study followed a retrospective observational and cross-sectional model (STROBE). The Kolmogorov Smirnov test, Student-t test, Wilcoxon Rank test, Mann-Whitney test, Pearson Chi-Square test, and binary and predictive logistic regression analysis were used, adopting a confidence risk of 0.05. **Results and Conclusion:** A total of 18 patients were included (12 PAS and 6 PSP). For the PAS group, the mean time to fracture healing on radiography was 9.92 weeks, and for the PSP group, it was 11.83 weeks. Using predictive logistic regression analysis, PAS and PSP consolidation times showed a statistically significant difference in data distribution (with p=0.888>0.05), and Haraguchi's classifications for PAS and PSP did not show a statistically significant association, with p>0.05. The two techniques, anteroposterior screw fixation posterior support plate, have advantages and disadvantages inherent to the procedure, as well as the surgeon's aptitude for each technique can be a confusing factor for the study. Little discrepancy was observed in the clinical and radiographic outcomes of the patients analyzed.

Keywords: Ankle fractures. Posterior malleolus. Anteroposterior screw. Posterior support plate. Surgical treatment. Complications.

Introduction

Ankle fractures account for approximately 4% of all fractures, with an annual incidence of 124 in 100,000 people in the UK. More than a third of these contain involvement of the posterior malleolus [1]. Even so, their surgical fixation remains the subject of debate. Recent treatment protocols indicate surgical fixation when there is joint involvement, involving 25-33% of the surface of the tibial pilon [2-6].

Regarding ankle fractures, Haraguchi et al. [7] were the first to create a classification system based on fragment morphology rather than size. Type I - oblique posterolateral; Type II - Transverse trait that extends from the fibular notch to the medial malleolus; Type III

- Small cortical fracture of the posterior malleolus, shell type. They also suggest that all fractures of the posterior malleolus benefit from a pre-operative tomographic study, to better appreciate the fragment's morphology.

When opting for surgical treatment, in most cases closed reduction and fixation with percutaneous screws (anterior and posterior) are used. Another technique is described, that of the posterior plate, open reduction internal fixation (ORIF), generally used when a satisfactory result is not obtained in closed reduction. Bearing in mind the surgeon's skill and preference, the use of ORIF in multifragmented posterior malleolus fractures is well known [8]. As occurs in joint fractures, anatomical reduction is always sought, due to a large percentage of osteoarthrosis, if not anatomically fixed [9].

Therefore, the present study aimed to analyze and compare the anteroposterior screw (PAS) and posterior support plate (PSP) techniques in postoperative results and percentage of complications, comparing radiographic and functional results in the surgical treatment of the posterior malleolus, as well as identifying cases of posterior malleolus fractures treated surgically and the epidemiological profile of patients, fracture characteristics, evidence of consolidation and complications observed postoperatively.

Methods

Study Design

The present study followed a prospective observational and cross-sectional model, following the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) rules. Available at: https://www.strobe-statement.org/checklists/. Accessed on 10/02/2024. This is a retrospective study including patients treated at Base Hospital - Sao Jose do Rio Preto, Sao Paulo, Brazil by the orthopedics team, specializing in the foot and ankle, who presented with a posterior malleolus fracture and underwent surgical treatment (ORIF (with plate and screw) or closed reduction and percutaneous fixation), from January 2019 to October 2021.

Ethical Approval

This study was approved by the Research Ethics Committee of FAMERP, Faculty of Medicine of São José do Rio Preto, São Paulo, Brazil under protocol 6.193.363, following the 1964 Declaration of Helsinki. Informed consent is not applicable as the study is retrospective.

Participant Analysis and Eligibility

An analysis of the medical records was carried out with anamnesis, physical examination, and anteroposterior and lateral ankle radiographs recorded in the institution's electronic system. The inclusion criteria involve fractures of the posterior malleolus with more than 0.5 cm of joint displacement and a bone fragment larger than 15% of the joint treated surgically. The exclusion criteria were another associated fracture, conservative treatment of the fracture, and follow-up for less time than consolidation.

Groups

Participants in the PAS Group (n=12) underwent anteroposterior screw fixation (PAS), and those in the PSP Group (n=6) underwent osteosynthesis with a posterior support plate (PSP).

Data Analysis

The data were organized in an Excel spreadsheet, with statistical evaluation of the information by the foot/ankle team, using the Haraguchi classification and seeking to identify complications during follow-up, as well as comparing the average time for fracture consolidation, seen on radiographs. After data collection, they were spreadsheeted in Excel. Descriptive statistical analysis was performed based on calculations of central tendency dispersion measures and frequency counts. For the inferential statistical analysis of quantitative variables, the Kolmogorov-Simirnov Test was used to verify the normality of the data. The Student-t test was then used for parametric variables, with $p>0.05$ without a significant statistical difference (Does not reject the null hypothesis H_0). The non-parametric Wilcoxon Rank Test was performed, with $p<0.05$ with a statistically significant difference between the medians (rejects the null hypothesis H_0). Using the Mann-Whitney test, the medians of PAS and PSP consolidation time were compared, with $p<0.05$ with a statistically significant difference between the medians (rejects the null hypothesis H_0). Using Pearson's Chi-Square test, the statistically associated variables presented $p<0.05$ (rejecting H_0). Binary and predictive logistic regression analysis was performed with significant $p<0.05$, rejecting the null hypothesis (H_0).

Results

A total of 18 patients who met the inclusion criteria in the present study were included. Of these, 9 are female (50%) and 9 are male (50%). Participants have a mean age of 43.3±13.1 years (range 28-74) with 12 patients undergoing percutaneous anteroposterior screw fixation (66.66%) and 6 undergoing posterior plate osteosynthesis (33.33 %). The average follow-up

time was 7.5±3.3 months (range 3-15) (Table 1).

Of the PAS group, the mean time to fracture healing on radiograph was 9.92 weeks (range 5 - 32 weeks). Of these, three cases of the delayed union were identified (average of 18.6 weeks) as well as three postoperative complications (screw loosening, perisynthesis fracture, malunion in cubitus varus), which correspond to 25% of the sample. Considering the PSP group, which underwent osteosynthesis with a posterior support plate, an average consolidation time of 11.83 weeks was obtained (with a range of 5 - 20 weeks). Of these, three cases of delayed union (average of 16 weeks) and one postoperative complication (paraesthesia of the 5th toe, sural nerve zone) were identified. These correspond to 16.66% of the sample (Table 1).

In terms of normality, the numerical variables classified as age (p=0.234), follow-up (p=0.555), and consolidation time in the PSP group (p=0.743) presented a Gaussian distribution, with p>0.100, and only the time of total consolidation (p=0.005) and consolidation time in the PAS group (p=0.005) did not present a normal distribution, with p<0.100.

For quantitative variables (continuous predictors), the Student-t test was performed for the parametric variable "age" between the PAS and PSP groups, with respective mean values of 45.92±13.49 months (range: 28 to 74) and 38.17± 11.51 months (range: 28 to 54), obtaining p=0.000<0.05 with a statistically significant difference, and the non-parametric Wilcoxon Rank Test was performed for the total consolidation variable, with p>0.05 without statistical difference intragroup significance, and the Mann-Whitney test compared the medians of PAS and PSP consolidation time, finding p=0.294, with no statistically significant difference between the medians (rejects the null hypothesis H_0) (Table 1). However, when a more detailed analysis was carried out using predictive logistic regression analysis, it became clear that the PAS and PSP consolidation times showed a statistically significant difference in the distribution of the data, with p=0.888>0.05 (Figure 1).

Regarding qualitative variables, Pearson's Chi-Square test (X^2) was applied, finding that there was no significant statistical association between all variables, with p>0.05 (not rejecting H_0) (Table 1). Using Pearson's Chi-Square test, Haraguchi's classifications for PAS and PSP did not show a statistically significant association, with p=0.558>0.05 (not rejecting the null hypothesis H_0).

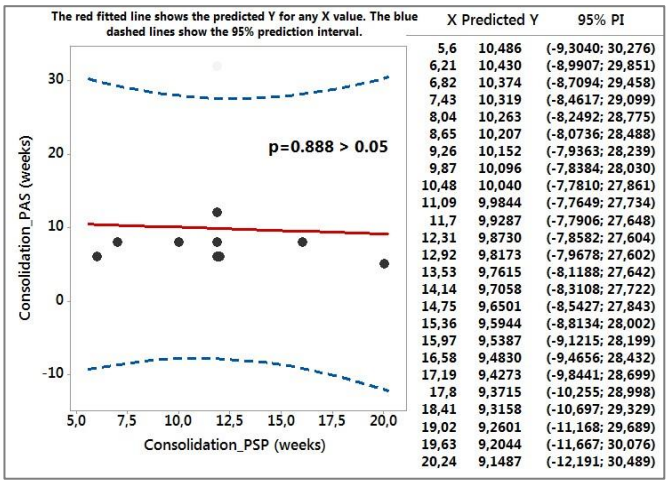
Table 1. General clinical data, numerical values, percentage, and p-value.

Clinical Data N=18 participants	Clinical Findings (results in absolute values and percentage, %)	p-value
Gender	• **Gender_Total:** ➢ Female: n=9 (50%) ➢ Male: n=9 (50%) • **Gender_PAS:**** ➢ Female: n=5 (41.7%) ➢ Male: n=7 (58.3%) • **Gender_PSP:**** ➢ Female: n=4 (66.7%) ➢ Male: n=2 (33.3%)	**p=0.921
Age_Mean	• **Age_Total:** 43.3±13.1 years (range: 28 to 74) ➢ **Age_PAS:** 45.92±13.49 years (range: 28 to 74)* ➢ **Age_PSP:** 38.17±11.51 years (range: 28 to 54)*	*p=0.000
Surgery Type	• **PAS:** n=12 (66.66%)** • **PSP:** n=6 (33,33%)**	**p=0.823
Laterality	• **Right:** n=11 (61,1%)** • **Left:** n=7 (38.9%)**	**p=0.766
Mechanism	• Run over: n = 1 (5.5%)** • Ankle sprain: n = 8 (44.4%)** • Traffic accident: n = 6 (33.4%)** • Fall from bicycle: n= 1 (5.5%)** • Ox drop: n= 1 (5.5%)** • Fall from stairs: n= 1 (5.5%)**	**p>0.05
Haraguchi Classification	**- Total:** • Type I: n=8 (44.5%)** • Type II: n=10 (55.5%)** • Type III: none **- PAS:** • Type I: n=6 (50.0%)** • Type II: n=6 (50.0%)** **- PSP:** • Type I: n=2 (33.3%)** • Type II: n=4 (66.7%)**	**p=0.558 >0.05
Complications	- **PAS: 25% of the complications** • Screw loosening; • Perisynthesis fracture; • Malunion in ulna varus. - **PSP: 16.66% of the complications** • Three cases of delayed consolidation (16 weeks); • Paresthesia of the 5th toe, sural nerve area.	None
Follow-up	• **Total:** 7.5±3.3 months • **Follow-up_PAS:** 7.17±3.79 months (range: 3 to 15)* • **Follow-up_PSP:** 8.17±2.23 months (range: 5 to 11)*	*p=0.493
Consolidation Time	• **Total:** 10.6±6.6 weeks (range: 5 to 32)+ • **PAS:** 9.92±7.29 weeks (range: 5 to 32)++ • **PSP:** 11.83±5.38 weeks (range: 6 to 20)++	+p=1.000 ++p=0.294

***Note:** Haraguchi Classification: Type I= oblique posterolateral; Type II= Transverse trait that extends from the fibular notch to the medial malleolus; PAS = Percutaneous Anteroposterior Screw; PSP= Posterior Support Plate.

*The Student-t test was performed for parametric variables, with p<0.05 with a statistically significant difference between the means (rejects the null hypothesis H0). +The non-parametric Wilcoxon Rank Test was performed, with p<0.05 with a statistically significant difference between the medians (rejects the null hypothesis H0). ++Mann-Whitney test, the medians of PAS and PSP consolidation time were compared, with p<0.05 with a statistically significant difference between the medians (rejects the null hypothesis H0). **By Pearson's Chi-Square test, the statistically associated variables present p<0.05 (rejecting H0).

Figure 1. Predictive logistic regression analysis between PAS and PSP consolidation times, with p<0.05 statistically significant in the 95% CI.



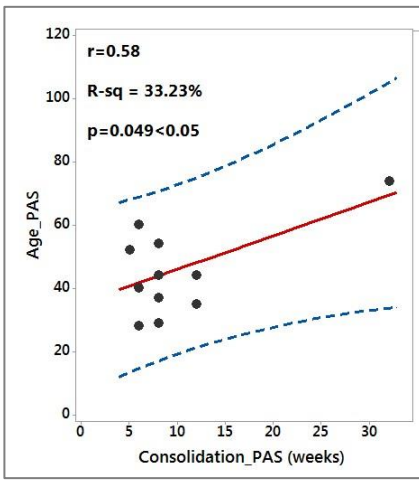
X	Predicted Y	95% PI
5,6	10,486	(-9,3040; 30,276)
6,21	10,430	(-8,9907; 29,851)
6,82	10,374	(-8,7094; 29,458)
7,43	10,319	(-8,4617; 29,099)
8,04	10,263	(-8,2492; 28,775)
8,65	10,207	(-8,0736; 28,488)
9,26	10,152	(-7,9363; 28,239)
9,87	10,096	(-7,8384; 28,030)
10,48	10,040	(-7,7810; 27,861)
11,09	9,9844	(-7,7649; 27,734)
11,7	9,9287	(-7,7906; 27,648)
12,31	9,8730	(-7,8582; 27,604)
12,92	9,8173	(-7,9678; 27,602)
13,53	9,7615	(-8,1188; 27,642)
14,14	9,7058	(-8,3108; 27,722)
14,75	9,6501	(-8,5427; 27,843)
15,36	9,5944	(-8,8134; 28,002)
15,97	9,5387	(-9,1215; 28,199)
16,58	9,4830	(-9,4656; 28,432)
17,19	9,4273	(-9,8441; 28,699)
17,8	9,3715	(-10,255; 28,998)
18,41	9,3158	(-10,697; 29,329)
19,02	9,2601	(-11,168; 29,689)
19,63	9,2044	(-11,667; 30,076)
20,24	9,1487	(-12,191; 30,489)

Source: Own Authorship.

The binary logistic regression analysis of the type of PAS surgery concerning the time of total consolidation showed Odds Ratio (OR) = 1.045 (CI 95% - 0.9014; 1.2112; Equation: Y' = -1.166 + 0.0439 Consolidation_Total (weeks)) versus OR=0.957 (CI95% - 0.8256; 1.1094; Equation: Y' = 1.166- 0.0439 Consolidation_Total (weeks)) of PSP surgery, both with p=0.560>0.05. These results show that with PAS surgery the chances of consolidation time are faster compared to PSP surgery, confirming the average values for consolidation time presented in Table 1 (PAS: 9.92±7.29 weeks versus PSP: 11.83±5.38 weeks).

Table 2 brings together the results of the logistic regression analysis of the variables "age" and "gender" to the outcomes "consolidation time" and "Haraguchi Classification". The results demonstrated that, to the type of PAS surgery, increasing age significantly influenced the increase in consolidation time, with p=0.049 (r=0.58 and R-sq=33.23%), highlighting that the average consolidation time of PAS was 9.92±7.29 weeks to the average age of 46 years, as shown in Figure 2. Regarding the type of PSP surgery, it was found that age did not influence the consolidation time, with p=0.591 (r= -0.28 and R-sq= 7.85%), highlighting that the average PSP consolidation time was 11.83±5.38 weeks to the average age of 38 years, as shown in Figure 3.

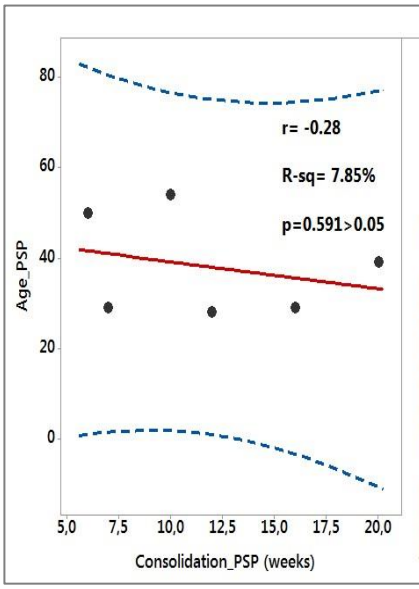
Figure 2. Predictive logistic regression analysis (Age_PAS versus Consolidation_PAS), with p<0.05 statistically significant at the 95% CI.



X	Predicted Y	95% PI
4	39,605	(12,055; 67,156)
5,2	40,886	(13,599; 68,172)
6,4	42,166	(15,085; 69,246)
7,6	43,446	(16,512; 70,379)
8,8	44,726	(17,879; 71,572)
10	46,006	(19,186; 72,825)
11,2	47,286	(20,431; 74,140)
12,4	48,566	(21,616; 75,515)
13,6	49,846	(22,740; 76,951)
14,8	51,126	(23,806; 78,445)
16	52,406	(24,814; 79,997)
17,2	53,686	(25,766; 81,605)
18,4	54,966	(26,664; 83,267)
19,6	56,246	(27,510; 84,981)
20,8	57,526	(28,307; 86,745)
22	58,806	(29,056; 88,555)
23,2	60,086	(29,761; 90,410)
24,4	61,366	(30,424; 92,308)
25,6	62,646	(31,047; 94,245)
26,8	63,926	(31,632; 96,219)
28	65,206	(32,183; 98,228)
29,2	66,486	(32,701; 100,27)
30,4	67,766	(33,189; 102,34)
31,6	69,046	(33,648; 104,44)
32,8	70,326	(34,081; 106,57)

Source: Own Authorship.

Figure 3. Predictive logistic regression analysis (Age_PSP versus Consolidation_PSP), with p<0.05 statistically significant at the 95% CI.



X	Predicted Y	95% PI
5,6	41,904	(0,80629; 83,001)
6,21	41,538	(1,1620; 81,914)
6,82	41,172	(1,4547; 80,890)
7,43	40,807	(1,6810; 79,932)
8,04	40,441	(1,8381; 79,044)
8,65	40,075	(1,9230; 78,227)
9,26	39,709	(1,9331; 77,486)
9,87	39,344	(1,8663; 76,821)
10,48	38,978	(1,7206; 76,236)
11,09	38,612	(1,4946; 75,730)
11,7	38,247	(1,1875; 75,306)
12,31	37,881	(0,79879; 74,963)
12,92	37,515	(0,32871; 74,702)
13,53	37,149	(-0,22207; 74,521
14,14	36,784	(-0,85238; 74,420
14,75	36,418	(-1,5606; 74,397)
15,36	36,052	(-2,3445; 74,449)
15,97	35,687	(-3,2018; 74,575)
16,58	35,321	(-4,1297; 74,771)
17,19	34,955	(-5,1252; 75,035)
17,8	34,589	(-6,1852; 75,364)
18,41	34,224	(-7,3064; 75,754)
19,02	33,858	(-8,4856; 76,202)
19,63	33,492	(-9,7195; 76,704)
20,24	33,127	(-11,005; 77,258)

Source: Own Authorship.

Furthermore, it was also found that for the female gender for the type of PAS surgery, the consolidation time may be more affected than the male gender, with OR=1.073 (0.8882; 1.2950) and OR =0.932 (0.7722; 1.1258), respectively. Regarding the type of PSP surgery, males were more affected than females in terms of consolidation time, with OR=1.50 (0.7957; 1.6560) and OR=0.871 (0.6039; 1.2568), respectively (Table 2).

To the Haraguchi Classification, the ages of both types of surgery were more related to Type I of the

Haraguchi Classification, with OR=1.015 (0.9291; 1.1094) for Type I versus OR=0.985 (0.9014; 1.0764) of type II for PAS, and OR=1.010 (0.9137; 1.1253) of Type I versus OR=0.998 (0.9022; 1.0875) of type II for PSP (Table 2).

Regarding gender in the type of PAS surgery, the Haraguchi Classification Type II was significantly related to the female gender, with OR=2.000 (0.1940; 20.6140), and the Haraguchi Classification Type I was significantly related to the gender male, with OR=2.000 (0.1940; 20.6140). Regarding gender in the type of PSP surgery, the Haraguchi Classification Type I was significantly related to the female gender, with OR=3.000 (0.0838; 107.4472), and the Haraguchi Classification Type II was significantly related to the female gender. male, with OR=3.000 (0.0838; 107.4472), as shown in Table 2.

Table 2. Results of the logistic and binary regression analysis on the influence of age and gender predictors on the response predictors of consolidation time and Haraguchi Classification of PAS and PSP, with $p<0.05$ with statistical significance.

Variables	*p-value; Odds Ratio; Interval*
Tempo de Consolidação PAS and Age_PAS	• **Reference: 46 anos (mean age)** (Figure 2) p=0.049
Tempo de Consolidação PSP and Age_PSP	• **Reference: 38 anos (mean age)** (Figure 3) p=0.591
Tempo de Consolidação PAS and Gender_PAS	• **Reference: Female:** p=0.428; OR=1.073 (0.8882; 1.2950) • **Reference: Male** p=0.428; OR=0.932 (0.7722; 1.1258)
Tempo de Consolidação PSP and Gender_PSP	• **Reference: Female:** p=0.444; OR=0.871 (0.6039; 1.2568) • **Reference: Male** p=0.444; OR=1.50 (0.7957; 1.6560)
Haraguchi Classification_PAS and Age_PAS	• **Reference: Haraguchi Type I** p=0.737; OR=1.015 • (0.9291; 1.1094) • **Reference: Haraguchi Type II** p=0.737; OR=0.985 (0.9014; 1.0764)
Haraguchi Classification_PSP and Age_PSP	• **Reference: Haraguchi Type I** p=0.688; OR=1.010 • (0.9137; 1.1253) • **Reference: Haraguchi Type II** p=0.876; OR=0.998 • (0.9022; 1.0875)
Haraguchi Classification_PAS and Gender_PAS	• **Reference: Haraguchi Type I (Female):** p=0.557; OR=0.500 (0.0485; 5.1535) • **Reference: Haraguchi Type II (Female)** p=0.557; OR=2.000 (0.1940; 20.6140) • **Reference: Haraguchi Type I (Male)** p=0.557; OR=2.000 (0.1940; 20.6140) • **Reference: Haraguchi Type II (Male)** p=0.557; OR=0.500 (0.0485; 5.1535)
Haraguchi Classification_PSP and Gender_PSP	• **Reference: Haraguchi Type I (Female)** p=0.545; OR=3.000 (0.0838; 107.4472) • **Reference: Haraguchi Type II (Female)** p=0.545; OR=0.333 (0.0093; 11.9386) • **Reference: Haraguchi Type I (Male)** p=0.545; OR=0.333 (0.0093; 11.9386) • **Reference: Haraguchi Type II (Male)** p=0.545; OR=3.000 (0.0838; 107.4472)

Source: Own Authorship.

Discussion

This study analyzed and compared the PAS and PSP techniques, demonstrating the postoperative results and percentage of complications, comparing the radiographic and functional results in the surgical treatment of the posterior malleolus, as well as identifying the cases of posterior malleolus fracture treated surgically and the profile epidemiology of patients, characteristics of fractures, evidence of consolidation and complications observed in the postoperative period.

Thus, as the main results of the present study, it was observed that, through predictive logistic regression analysis, the PAS and PSP consolidation times showed a statistically significant difference in the distribution of data (with $p=0.888>0.05$) (Figure 1), and the Haraguchi classifications for SBP and PSP did not show a statistically significant association. With PAS surgery, the chances of consolidation time are faster compared to PSP surgery (Table 2), following some literature results [2-4].

Regarding the type of PAS surgery, increasing age significantly influenced the increase in consolidation time. Furthermore, for the type of PAS surgery, consolidation time may be more affected in females than in males. Regarding the type of PSP surgery, males were more affected compared to females (Table 2).

According to the Haraguchi Classification, the ages of both types of surgery were more related to Type I of the Haraguchi Classification. The Haraguchi

Classification Type II was significantly related to the female gender (OR=2.000 (0.1940; 20.6140)), and the Haraguchi Classification Type I was more related to the male gender (OR=2.000 (0.1940; 20,6140)), both in PAS surgery. In the PSP surgery type, the Haraguchi Classification Type I was significantly related to the female gender, with OR=3.000 (0.0838; 107.4472), and the Haraguchi Classification Type II was significantly related to the male gender, with OR=3.000 (0.0838; 107.4472) (Table 2), according to similar results found in the literature [3,4].

Therefore, in the case of a joint fracture, the importance of reestablishing joint congruence [10] is well highlighted in the literature, whether for the radiographic or clinical outcome of patients, with the open reduction and internal fixation technique being the best indicated for absolute stability parameters are reached. However, the patient's epidemiological profile must be taken into account, such as age, level of previous activity, bone quality, and habits, among others, for this reason, the minimally invasive technique is well indicated in elderly patients, with vascular compromise that may affect surgical wound healing, as well as smokers and patients with low levels of activity [11,12].

Although not established in the literature, surgical treatment is currently considered the method of choice for fractures of the posterior malleolus compromising more than 25% of the articular surface [6]. When it comes to the surgical approach, the potential for complications and average consolidation time is of great interest for the good management of the condition. According to the results of this study, fractures treated with closed reduction and fixation with percutaneous anteroposterior screws have a mean healing time shorter than ORIF with a posterior support plate (9.83 weeks x 10.8 weeks). Another positive point can be considered in favor of the technique, which did not present complications with surgical wound infection and paresthesia, most likely due to its less invasive characteristic (in contrast to a case seen in the PSP group). There was no case of infection, but it is known that longer surgical time and more invasive surgery have a greater chance of postoperative infection.

In the PSP group, there were no cases of varus malunion, seen in the percutaneous technique group, possibly due to the greater ease in performing fragment reduction. A lower percentage of complications was identified in this group (16.66% of PSP x 25% of PAS) (Table 1), with different characteristics of the complications, associated with the surgical technique, with the percutaneous technique being more challenging to obtain anatomical reduction of the fracture, as well as the open technique presents a greater risk of contamination.

In this context, a meta-analysis study carried out by the authors Espinosa-Uribe et al. (2023) [13] compared the use of cannulated screws versus plate with screw fixation in terms of their impact on the development of postoperative ankle osteoarthritis and functional outcomes in patients with posterior malleolus fractures. 691 articles were screened and the results revealed no statistically significant difference in the development of postoperative ankle osteoarthritis between the cannulated screw and plate with screw fixation groups. Likewise, there was no significant difference in functional outcomes between the two treatment approaches.

Finally, the authors Sun, Shi, and Du (2024) [14] analyzed the biomechanical effect of six fixation methods for the treatment of posterior malleolus fractures using the finite element method. Fixation models include five different cannulated screw fixation models (0°, 5°, 10°, 15°, 20°) and one posterior plate fixation model. Von Mises stress (VMS) and displacement were used as criteria to evaluate the biomechanical efficiency of different fixation models. The results demonstrated that the VMS and displacement increased as the load increased. The buttress plate presents better results in fixed strength and biomechanics than screws. When the screw fixation angle is 15°, the model has better-fixed strength and biomechanical stability than other screw fixation models.

Conclusion

The two techniques, anteroposterior screw fixation posterior support plate, have advantages and disadvantages inherent to the procedure, as well as the surgeon's aptitude for each technique can be a confusing factor for the study. Little discrepancy was observed in the clinical and radiographic outcome of the patients analyzed, making it necessary to carry out randomized clinical studies with a larger sample size and longer follow-up period, for the effectiveness of a meaningful comparative analysis. Treatment must be individualized, based on the characteristics of the fracture, the patient's profile, and the surgeon's experience with the technique.

CRediT

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Ethical Approval

This study was approved by the Research Ethics Committee of FAMERP, Faculty of Medicine of São José do Rio Preto, São Paulo, Brazil under protocol 6.193.363, following the 1964 Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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