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Original Article

Arthrodesis in Müller-Weiss disease: is it worth keeping the navicular bone?

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Abstract

Objective: Compare a case series diagnosed with Müller-Weiss disease and whether or not maintaining the diseased navicular bone influences the outcome of the arthrodesis.

Methods: A retrospective clinical study that evaluated patients with Müller-Weiss disease (phases 3 and 4 of Maceira's classification) submitted to surgery. The patients were divided into two groups. Group A included six patients (six feet), in whom all the navicular bone was removed, and a tricortical graft was used to replace it. Group B also included six patients (six feet) without removed navicular bone. The mean follow-up time was 101 months. For evaluation, clinical and radiographic criteria were used, including The American Orthopaedic Foot & Ankle Society (AOFAS) scale for ankle and hindfoot and the Visual Analog Scale (VAS).

Results: The mean consolidation time for arthrodesis was 18 weeks in group A and 16 weeks in group B. The radiographic angles in the preoperative and postoperative did not show significant changes. In group A, the preoperative mean AOFAS score was 45 points, and the postoperative was 80 points. In group B, the preoperative mean AOFAS score was 48 points, and the postoperative was 79 points. The mean VAS value was 2.5 in group A and 2.4 in group B. The pseudarthrosis index was the same in both groups, 33.3% (2 of the 6 feet).

Conclusion: No significant differences were found between maintaining or replacing the navicular bone by tricortical bone graft in the midfoot arthrodesis in patients with Müller-Weiss disease.

Level of Evidence III; Therapeutic Studies - Investigating the Results of Treatment; Retrospective Comparative Study.

Keywords: Arthrodesis; Bone transplantation; Flatfoot; Osteochondrosis.

Introduction

Müller-Weiss disease was described in 1927 by Müller and Weiss in separate articles[1]. It is characterized by deformity, sclerosis, and fragmentation of the navicular, a condition that can lead to chronic pain in the foot[2]. It is more common in women and is a rare entity, with etiology not yet fully understood. The classic clinical symptoms are chronic pain in the foot, located in its dorsomedial aspect[2].

Surgery is indicated when conservative treatment fails. A surgical option is talonavicular arthrodesis (TNA) alone or associated with naviculocuneiform arthrodesis (NCA). However, there is a doubt in case of an indication of arthrodesis: should all the navicular bone be removed, filling the space left with structured bone graft, or can part of this collapsed bone be preserved? Despite the few cases, our study tries to answer this question, which has not yet been answered in the literature worldwide.

The objective of this study is to evaluate the clinical-functional and radiographic results of patients submitted to midfoot arthrodesis due to symptomatic arthrosis caused

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by Müller-Weiss disease. Also, compare the results between cases where a tricortical iliac bone graft was used with those where the navicular bone and graft were used to fill the bone failure.

Methods

This study was approved by the institution's ethics committee. Patients diagnosed with Müller-Weiss disease treated between 1994 and 2013 were included in this study. In total, 26 patients (31 feet) were registered and reassessed. Initially, conservative treatment was indicated in all cases (insole supporting the medial longitudinal arch or leg-foot orthosis). In 18 patients (21 feet), conservative treatment failed, and surgery was indicated. Two refused to participate in the study, and one had less than one year of follow-up. Then, 15 patients (16 feet) were evaluated. The mean follow-up time was 101 months (range 12 to 234 months). Two patients were male, and 13 were female. The mean age at the time of surgery was 44 years (range 23 to 56 years). The classification proposed by Maceira[1] to stratify these cases was used. Only patients in phases 3 and 4 of this classification were included and divided into two groups to compare the results. Group A: six patients in whom the entire navicular was removed, and a tricortical iliac bone graft was used to fill the space in the midfoot arthrodesis. The mean age in this group was 43 years (range 23 to 51 years). The mean body mass index (BMI) was 26.3 (range 21 to 32). The mean follow-up was 97 months (minimum 39 and maximum 180 months). Group B: six patients in whom their navicular was used as a bone graft for arthrodesis. The medial part of this bone is usually not affected by the disease and was used as a bone graft. The mean age in this group was 44 years (range 35 to 56 years). The mean BMI was 26.4 (range 23.2 to 30.1). The mean follow-up was 140 months (minimum 12 and maximum 234 months).

Each group consisted of four patients in phase 3 and two in phase 4. In group A, in all operated feet where the navicular was removed, the joint between the talonavicular (TC) and the naviculocuneiform (NC) was necessarily arthrodesed. In addition, plates and screws were used in five patients, and only wires in one. In group B, fixation screws were used in four feet, and only wires in two. Patient data, arthrodesed joints, and additional surgeries are shown in Table 1. Arthrodesed joints were considered symptomatic and with signs of radiographic degeneration.

This is a clinical, retrospective, and comparative study. The choice to remove or not the navicular bone was based on the surgeon's criteria.

The patient's medical records for reports of suture dehiscence, skin necrosis, or infection were searched to evaluate the results. In the patient's clinical examination in the outpatient return, painful points in the foot were explored, and the Visual Analog Scale (VAS) was used[3]. The preoperative pain could not be evaluated, as this data was not included in the patient's medical record. The American Orthopaedic Foot and Ankle Society (AOFAS)[4] scale for hindfoot was used for clinical-functional evaluation. The radiographs in the dorsoplantar, lateral (both performed with load), and oblique views were also used. In the preoperative radiographs, an alteration in the navicular bone was sought and used for Maceira's classification[1]. The presence of arthrosis in the TN and NC joints was studied. The angles between the talus and the first metatarsal bone were used to measure the deformity in the dorsoplantar and profile views (in the profile, this measure is known as Meary's line). The resolution of pain complaints and the presence of bone trabeculation crossing

Table 1. General data of patients with Müller-Weiss disease submitted to arthrodesis and evaluated in this study

N	Group	Age (Y)	Sex	Follow-up (M)	BMI	Side	Maceira's classification	Arthrodesis	Fixation method
1	A	23	F	180	21	R	3	TN+NC	K-WIRE
2	A	49	F	108	25.7	R	4	TN+NC	PL/SC
3	A	50	F	123	25.7	L	4	TN+NC	PL/SC
4	A	43	F	74	28.6	L	4	TN+NC+ NC1M	PL/SC
5	A	51	M	39-	32	L	4	TRIPLE+NC	PL/SC
6	A	45	F	44	26.7	L	3	TN+NC+ NC1M	PL/SC
	Mean	43		97	26.3				
7	B	39	F	234	27	R	3	TN	SC
8	B	35	F	216	23.3	L	4	TN+NC	K-WIRE
9	B	38	F	197	25.8	R	4	TRIPLE	K-WIRE
10	B	44	F	62	30.1	R	3	TN	SC
11	B	56	F	12	27	R	4	TRIPLE	SC
12	B	54	F	18	25.2	R	4	TRIPL+NC	SC
	Mean	44		140	26.4				

N: Number; F: Female; M: Male; Y: Years; M: Months; BMI: Body Mass Index; R: Right; L: Left; TN: talonavicular; NC: naviculocuneiform; NC1M: joint between the NC and the first metatarsal bone; K-wires: Kirschner wires; PL/SC: Plate and screws; SC: Screws
Source: Medical archives of Santa Casa de Misericórdia de São Paulo

the focus of arthrodesis on radiographs are considered signs of consolidation. After six months, if the patient persisted with pain in the arthrodesis, and there were no radiographic signs of consolidation, loosening and/or breakage, it was considered pseudarthrosis and treatment failure. The time required for arthrodesis to be consolidated on radiographic examination was also noted.

Results

In group A, the mean consolidation time for arthrodesis was 18 weeks. The radiographic angles measured preoperatively and postoperatively showed no significant changes (Table 2). The mean preoperative AOFAS was 45 points (range 30 to 64), while in the postoperative was 80 points (range 74 to 86). At the last outpatient evaluation, the mean postoperative VAS value was 2.5 (range 1 to 4).

In group B, the mean consolidation time for arthrodesis was 16 weeks. The radiographic angles measured preoperatively and postoperatively showed no significant changes (Table 2). The mean preoperative AOFAS was 48 points (range 15 to 62), while in the postoperative was 79 points (range 68 to 90). At the last outpatient evaluation, the mean postoperative VAS value was 2.4 (range 0 to 5).

A case of deep wound infection and suture dehiscence was observed. This case occurred in a patient with a BMI of 29, submitted to TNA and NCA, using a tricortical iliac bone graft and fixed with a T-plate and 3.5 mm screws. The patient was submitted to several debridements (three procedures) and intravenous antibiotic therapy until the resolution of the infection. In the last evaluation, the patient presented an AOFAS of 78 points and VAS of 4 points and had returned to work.

Pseudarthrosis was noted in four patients (two feet in each group). Three patients successfully underwent revision of the arthrodesis, and the other patient was asymptomatic and chose not to undergo surgery again. In the last evaluation, these four patients had a mean AOFAS of 81 points and a mean VAS of 1.25. In both groups analyzed, the pseudarthrosis rate was the same, 33.3% (two of the six feet). Of the four cases, three presented complications in the TN joint (triple arthrodesis; TN + NC; and triple arthrodesis + NC) and one in the NC joint (TN + NC + NC1M (joint between the NC and the first metatarsal bone)).

Discussion

The etiology of Müller-Weiss disease appears to be multifactorial. It is believed that an irregular load distribution in a bone that has undergone an altered ossification and with areas of possible ischemia due to its peculiar irrigation are factors associated with this disease[2,5,6]. Despite its description as navicular osteonecrosis[6,7], some histopathological studies did not provide evidence of bone necrosis[2,5,8–10]. As the navicular contributes to the NC and the medial longitudinal arch of the foot, when there is the characteristic dorsolateral collapse, the re-establishment of its length must correct the deformities produced by the disease[2,6,7,11,12]. When the treatment method chosen is arthrodesis, and the navicular is collapsed, one possibility is a tricortical bone graft, usually obtained from the patient's iliac crest[6,12,13], to maintain the NC length[5,14]. In addition to filling the navicular space, the bone graft has osteoconductive, osteoinductive, and osteogenic properties[15], which in theory, would facilitate bone consolidation[13,15]. However, while planning one of these reconstructions, the idea of using

Table 2. Results of patients submitted to arthrodesis and evaluated in this study

N	Group	Graft (Y/N)	Comp.	Pseu TN	Pseu NC	DP1M (pre/post)	Meary (pre/post)	AOFAS (pre/post)	Cons. (W)	VAS
1	A	Y	N	N	N	4º/4º	6º/4º	64/83	12	3
2	A	Y	Y	Y	N	2º/2º	6º/0º	30/74	24	4
3	A	Y	N	N	N	8º/4º	6º/4º	35/86	18	1
4	A	Y	Y	N	N	4º/4º	8º/2º	56/78	12	4
5	A	Y	N	N	N	0º/0º	0°/0º	32/79	16	2
6	A	Y	Y	N	S	4º/2º	0º/2º	54/80	24	1
	Mean					3.6º/2.6º	4.3º/2º	45.16/80	17.6	2.5
7	B	N	N	N	N	10º/0º	4º/4º	38/74	16	4
8	B	N	N	N	N	8º/0º	10º/6º	54/78	10	2
9	B	N	Y	Y	N	20º/12º	2º/4º	59/90	16	0
10	B	N	N	N	N	0º/0º	0º/0º	62/92	14	3
11	B	N	N	N	N	8º/4º	8º/4º	15/68	16	5
12	B	N	Y	Y	N	8º/2º	8º/2º	60/81	24	0
	Mean					9º/3º	5.3º/3.3º	48/78.83	16	2.4

TN: articulation between the talus and the navicular; NC: articulation between the navicular and the cuneiform; Pseu: pseudarthrosis; pre: preoperative; pos: postoperative; DP1M: Dorsoplantar radiographic of the foot and angle calculation between the axis of the talus and the first metatarsal; Meary: angle calculated in the profile of the foot formed by the axis of the talus the first metatarsal; VAS: Visual Analog Scale of postoperative pain.
Source: Medical Archives of Santa Casa de Misericórdia de São Paulo.

the navicular as an interposition graft arose, employing the medial part of the bone, usually not affected by the collapse and the size necessary to fill the space between the talus and the NC. We believe the navicular bone graft should have the same properties as the iliac bone graft, which assists in bone consolidation and avoids another surgical procedure to obtain the iliac graft. The decision to use or not use the navicular itself as a bone graft was made at the time based on the surgeon's criteria responsible for the case. This retrospective study was conducted to evaluate the results of these cases and compare the results in which the patient's own tricortical iliac graft was used. When Madeira's classification was applied[1] in the cases, we noticed that it would be possible to make a comparative study with six patients in each group.

One of the concerns was how much the bone graft of the navicular itself could affect the arthrodesis consolidation since the disease is related to osteonecrosis[2,5,6]. Lu et al.[9] observed about 23% of pseudarthrosis in cases where only the TN joint was arthrodesed. Yu et al.[6] did not observe pseudarthrosis in seven cases submitted to TNA and NCA using a tricortical iliac graft to maintain the NC length and plate and dorsal screws for fixation. In our cases, however, there was pseudarthrosis in four of twelve, with two patients in each group. Despite the small number of cases, it does not seem that the use of the navicular itself as a graft affected consolidation. The size of bone failure was not measured in the surgery and may have varied a little from patient to patient; however, according to Azi et al.[15], there is no clinical evidence to prove a direct relationship between the size of bone defect and consolidation when using an autologous bone graft. These numbers encourage using the navicular as bone filling, avoiding another surgery to remove the iliac crest graft.

Surgical treatment of Müller-Weiss disease should relieve pain and correct deformities[2,5,9,16]. Several types of arthrodesis are recommended in the literature[2,5,7,9,11,17], and some authors suggest using allograft to fill the navicular failure in the midfoot[14,16]. In this case series, we sought to surgically address joints with pain on clinical examination and joint degeneration on radiographic examination. For this reason, the type of arthrodesis performed was not the same in all patients. The fixation method also varied and was defined by the surgeon's preference. Once consolidated, arthrodesis usually leads to good results[6,9,11,14,16,17]. The AOFAS scale for the hindfoot and ankle was used to evaluate the final clinical-functional result. Our patients had a mean score of 79 points, with no difference between the patients in whom the navicular graft was used (80 points) and the tricortical iliac graft group (78.5 points). Studies that used arthrodesis to treat Müller-Weiss disease, which also used the same scale, obtained a mean of between 82 and 90 points[6,7,9,11,12,14].

In Müller-Weiss disease, some factors that hinder consolidation have to be considered. The navicular blood supply (has its peculiarities, and surgical aggression can lead to damage to this circulation), and the shape of the TN joint (which hinders an adequate preparation of the surfaces to be arthrodesed), are factors that can hinder the arthrodesis consolidation in the midfoot[7,9]. In our study, the radiographic consolidation ranged between 16 and 18 weeks. Harnroongroj and Chuckpaiwong[17] describe isolated TNA to treat phase 3 of Maceira's classification and observed arthrodesis consolidation around two months. They suggest that the consolidation time in triple and perinavicular arthrodesis or when other joints are involved may be longer. Zhang and Yu[12] reported a mean consolidation time of 13 weeks in 49 patients submitted to TNA and NCA with tricortical iliac graft interposition. The arthrodesis fixation was performed with plates and screws, and the consolidation time was shorter than in our study. Yu et al.[6] also described TNA and NCA with iliac tricortical graft interposition, fixed with dorsal plate and screws, and with a mean consolidation time of 13 weeks. No differences in consolidation time were found between patients fixed with a plate and screws from the other patients, including two of the four cases of pseudarthrosis; the fixation method was plate and screws. In our opinion, noting that 1/3 of the cases treated in this study developed pseudarthrosis, the surgeon should pay extra attention to preparing the surfaces to be arthrodesed, and careful not to injure the surrounding soft tissues, avoiding damage to the local circulation.

The angle between the axis of the talus and the first metatarsal bone was used in the dorsoplantar radiograph with load (adduction) and lateral radiograph with load (flat feet) to evaluate the correction of adduction and deformity in flat feet. Despite finding an improvement in these radiographic parameters, we cannot conclude that this finding was significant. Harnroongroj and Chuckpaiwong[17] also observed an improvement in radiographic parameters without statistical significance. Cao et al.[14] proposed an osteotomy in the TN joint region to correct deformities. Based on the results, we do not find that an osteotomy is necessary to correct the deformities, especially in the TN region, which is a spherical joint. The simple removal of the articular cartilage already provides the space required for correcting deformities in most cases, as demonstrated in this study.

This study has some limitations. It is a retrospective study evaluating cases already operated. The choice to use the navicular or iliac graft was based on the surgeon's criteria and not on objective criteria. The number of patients evaluated is also small, but comparing phases 3 and 4 of Maceira's classification is an important study point. However, the number of patients evaluated was the same in both groups, additional surgeries between cases and the fixation method varied, affecting the result. The follow-up time is an important factor in this study. Comparing two similar groups according to the classification used was also important in evaluating this study.

Conclusion

In the foot arthrodesis due to Müller-Weiss disease's sequelae, the incidence of pseudarthrosis was high, at about 30%. Still, in most cases, there was an improvement in pain without total pain relief. To fill the medial space left by the necrotic bone, using tricortical iliac graft and the navicular bone led to similar clinical-functional results.

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