Mennen Plate Fixation for the Treatment of Periprosthetic Femoral Fractures

A Multicenter Study of Thirty-six Fractures

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Background: The management of periprosthetic femoral fractures after total hip and knee replacement remains difficult and controversial. This study was performed to determine the results of Mennen plate fixation for the treatment of periprosthetic femoral fractures.

Methods: This retrospective multicenter study consists of a review of a consecutive series of thirty-five patients in whom a total of thirty-six periprosthetic femoral fractures were treated with Mennen plate fixation. The average duration of follow-up was twenty-seven months (range, eight to forty-six months).

Results: Twenty-six fractures (72%) had united at an average of five months (range, three to ten months) after surgery. One of them had varus bending (10°) of the plate. The remaining ten fractures had a nonunion and varus bending (20° to 30°) of the plate, with a fracture of the plate in eight. A revision procedure was successfully performed in the eight patients with nonunion.

Conclusions: The treatment of unstable periprosthetic femoral fractures with Mennen plate fixation was complicated by high rates of mechanical failure (31%) and nonunion (28%). For this reason, we do not recommend the use of the Mennen plate for the treatment of periprosthetic femoral fractures.

The management of periprosthetic femoral fractures is problematic. Several nonoperative and operative treatment options have been reported[1-14]; however, many of them are associated with high rates of complications involving malunion, nonunion, refracture, and/or mechanical failure of the fixation device[15].

Mennen[16] originally designed a clamp plate to stabilize fractures of non-weight-bearing bones. After successful results with the use of this plate in metacarpal and forearm fractures[17-19], the plate was further developed for use in weight-bearing bones, such as the femur[20]. Although the initial results with the Mennen plate in periprosthetic femoral fractures seemed encouraging[20,21], the findings of subsequent reports were more disappointing[22,23]. However, a major shortcoming of these studies was the inclusion of only small numbers of patients (see Appendix)[20-37].

Therefore, in order to assess the effectiveness of the Mennen plate in the treatment of periprosthetic femoral fractures, we performed a multicenter study of thirty-six fractures.

Materials and Methods

We retrospectively reviewed the cases of patients with a periprosthetic femoral fracture that was treated with the Mennen plate (CMW Laboratories, Exeter, England) (Fig. 1). We included patients who were treated at twenty-one institutions in the Netherlands. These twenty-one institutions were all visited by one of the authors (R.J.P.N.) to gather the data on the selected patients. The medical records and radiographs of all of the patients were reviewed with use of a standard protocol. Preoperative data, including the age and gender of the patient, the primary operation, whether there had been a previous operation for the fracture, or any previous complications, were noted. Intraoperative details of the plate fixation were noted with particular attention to whether any additional fixation technique was used to stabilize the fracture. Postoperative details, particularly the weight-bearing regimen, were collected. Plain radiographs, which had been obtained on a regular basis, were reviewed to ascertain the type of fracture (according to the classification system of Johansson et al.[8]), the results of fixation, the time to union, and the presence of complications, such as bending, fracture, and/or loosening of the device.

From 1994 to 1997, thirty-five patients with thirty-six periprosthetic femoral fractures were treated with the Mennen plate. The patients were followed for a mean of twenty-seven months (range, eight to forty-six months). There were

TABLE I Data on the Parameters for the Thirty-six Periprosthetic Femoral Fractures in Thirty-five Patients

Case	Gender, Age *(yr)*	Primary Operation*	Classification According to Johansson et al.[8]	Previous Ops. to Treat Fracture	Previous Complications	Other Procedures Performed with Mennen Plate Fixation	Duration of Follow-up *(mo)*	Postop. External Support	Varus Deformity of Mennen Plate *(deg)*
1	F, 80	THA/TKA	II	AO plate, grafting	Nonunion	Screws, grafting	36	No	30
2	F, 65	Rev. THA/TKA	III	No	No	Grafting	25	Brace	30
3	F, 84	Rev. TKA	II	2 AO plates	Nonunion, plate failure	Grafting	36	No	20
4	M, 51	THA	II	No	No	Grafting	36	No	No
5	F, 64	Rev. THA/ Rev. TKA	III	No	No	No	39	No	No
		THA	II	No	No	No	39	No	30
6	M, 77	THA	II	No	No	Cerclage	42	No	No
7	F, 92	THA	II	No	No	Long-stemmed revision prosthesis	46	No	No
8	F, 61	TKA	II	No	No	Cerclage	31	No	No
9	F, 82	THA	II	No	No	No	33	No	30
10	F, 83	Rev. THA	II	Partridge	Nonunion	Grafting, OrthoPulse	40	Cast	10
11	M, 78	THA	III	No	No	Cerclage	42	No	No
12	F, 70	HA	III	No	No	No	36	No	30
13	F, 75	THA	I	No	No	Screws	32	No	No
14	F, 79	Rev. THA	III	No	No	Screw, cerclage, grafting	35	No	30
15	F, 70	THA	II	No	No	No	32	No	No
16	F, 77	THA	III	No	No	Long-stemmed revision prosthesis	29	No	No
17	F, 72	THA	II	No	No	No	34	Cast	30
18	F, 70	Rev. THA	III	No	No	No	32	Thomas splint	No
19	F, 84	Rev. THA	I	No	No	Long-stemmed revision prosthesis	16	No	No
20	F, 86	Rev. THA	II	No	No	Cerclage	27	Cast	No
21	F, 81	THA	III	No	No	Cerclage	12	No	20
22	F, 70	THA	I	No	No	No	15	No	No
23	F, 84	THA	I	No	No	Cerclage, grafting	22	No	No
24	F, 72	THA	III	Mennen plate	Fixation failure	Cerclage, grafting	14	No	No
25	F, 81	THA	II	No	No	Cerclage, screws	19	No	No
26	F, 80	THA	III	No	No	Cerclage	16	No	30
27	F, 82	THA	I	No	No	Cerclage	10	No	No
28	M, 42	THA	I	AO plate	Plate failure	No	12	No	No
29	F, 84	THA	II	No	No	Screws	17	No	No
30	F, 81	THA/TKA	I	No	No	Screws, cerclage	19	No	No
31	F, 78	Rev. THA	II	No	No	Long-stemmed revision prosthesis	13	No	No
32	M, 61	THA/TKA	II	No	No	Grafting	18	Cast	No
33	F, 78	THA	I	No	No	Screws	27	No	No
34	F, 67	THA	III	No	No	Cerclage	8	No	No
35	F, 58	Rev. THA	I	No	No	Grafting	16	No	No

*THA = total hip arthroplasty, TKA = total knee arthroplasty, and HA = hemiarthroplasty.

Fig. 1
Photograph showing the Mennen plate fixation device (CMW Laboratories, Exeter, England).

thirty women and five men. The average age at the time of the periprosthetic fracture was seventy-four years (range, forty-two to ninety-two years). Twenty-eight fractures occurred after a total hip arthroplasty (seven occurred after a revision procedure). Two fractures occurred after a total knee arthroplasty (one after a revision procedure). Five fractures occurred between a total hip arthroplasty and a total knee arthroplasty (two occurred after a revision procedure). One fracture occurred after a hemiarthroplasty of the hip (Table I).

Classification of the Fractures

All fractures were classified according to the system of Johansson et al.[8]. There were nine type-I, sixteen type-II, and eleven type-III periprosthetic fractures. Except in four cases, all prostheses were well fixed at the time of presentation.

Operative Treatment

In five fractures (Cases 1, 3, 10, 24, and 28), Mennen plate fixation was used after failure of other osteosynthesis techniques. In four fractures (Cases 7, 16, 19, and 31), loosening of the prosthesis accompanied the fracture and Mennen plate fixation was combined with a long-stemmed revision procedure. In eight fractures (Cases 5, 9, 12, 15, 17, 18, 22, and 28), the Mennen plate was used alone. In the remaining cases, Mennen plate fixation was combined with other osteosynthesis techniques.

Postoperative Management

After recovering from surgery, the patients were managed with non-weight-bearing on the involved limb with the assistance of crutches. The non-weight-bearing regimen was continued until clinical and radiographic signs of union were present. In six fractures (Cases 2, 10, 17, 18, 20, and 32), an external support (a brace, cast, or Thomas splint) was used postoperatively. If the general condition of the patient did not permit the non-weight-bearing regimen, the patient was managed with bed rest or used a wheelchair. In one fracture (Case 10), a pulsed electromagnetic field device (Ortho-Pulse, IMD, Uden, The Netherlands) was used immediately postoperatively.

Results

Clinical and Radiographic Evaluation

Union was evident radiographically in twenty-six fractures (72%) at a mean of five months (range, three to ten months) after surgery (Fig. 2). In one of these fractures, varus bending of the plate (10°) occurred. All patients were pain-free and were able to walk with or without the assistance of crutches.

Nonunion was found in the remaining ten fractures (28%). All of these fractures had varus bending of the plate (20° to 30°), with a fracture of the plate in eight (Fig. 3). Eight

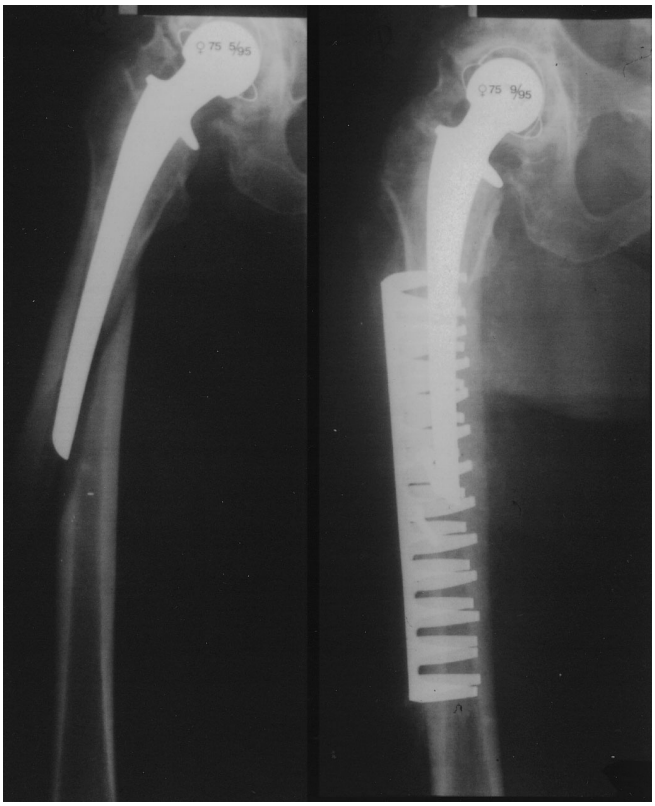

Fig. 2
Anteroposterior radiographs of a patient (Case 13), showing a type-I periprosthetic femoral fracture, according to the classification system of Johansson et al.[8], that occurred after a total hip arthroplasty (left) and the result four months after treatment with a Mennen plate and screw fixation (right).

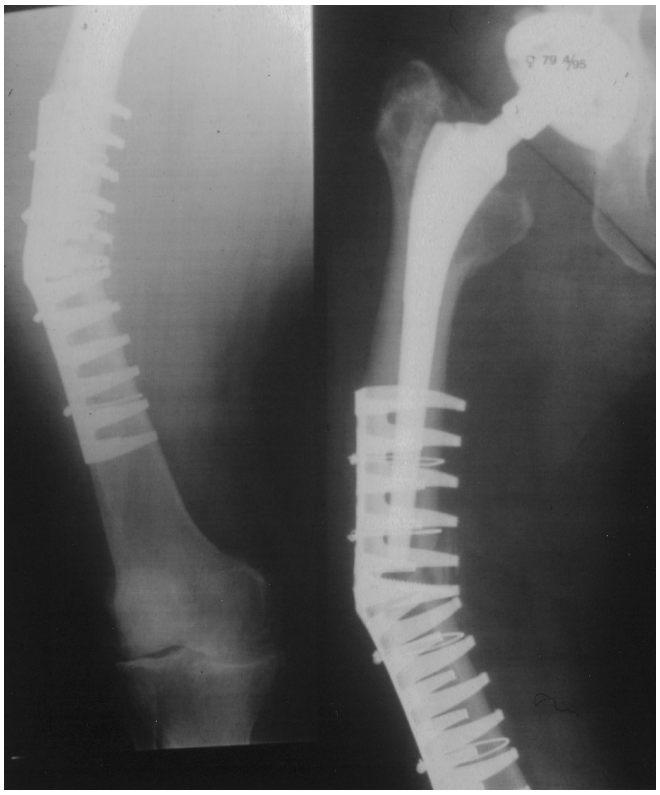

Fig. 3
Anteroposterior radiograph of a patient (Case 14), showing failure of Mennen plate fixation.

nonunions were managed successfully with a revision (a long-stemmed revision prosthesis and an AO plate combined with a graft were used in four patients each). Two nonunions were treated nonoperatively because of the poor medical condition of the patient.

Discussion

Periprosthetic femoral fractures are rare and occur more frequently after revision arthroplasty than after primary arthroplasty[38,39]. The prevalence of postoperative femoral fracture after revision total hip arthroplasty has been reported to be as high as 4.2% in a series of 206 patients followed at the Mayo Clinic[38] and 2.3% in a series of thirty patients after primary total hip arthroplasty[39]. Management of these fractures remains difficult and is controversial. If a periprosthetic fracture is accompanied by loosening of the prosthesis, a revision procedure is usually recommended[40,41]. Without loosening, the implant can be preserved and various treatment options have been described[1-14,42-46]. However, all of these options may be associated with serious complications and their own specific limitations[15].

In 1978, Mennen developed a clamp plate as a method to treat unstable shaft fractures[16-19]. He claimed that the technique was simple and less time-consuming than others. In addition, he claimed that, because of the clamping mechanism and the position of the plate, periosteal stripping and interference with the paraosseous blood supply could be avoided. The latter might be particularly important in periprosthetic fractures as the endosteal blood supply may be affected by the intramedullary prosthesis.

Lam and Purkayastha reported successful results after using the Mennen device in six periprosthetic femoral fractures[20], and good results have been described by others[21,29,35]. Mennen plate fixation was also successfully used for the treatment of periprosthetic femoral fracture in combination with a revision procedure, even in patients with severe bone loss and/or aseptic loosening of the prosthesis[24,26-28]. However, several other studies have shown less favorable results[22,23,25,31-34,36,37]. Difficulties with the application of the plate (and the need for substantial exposure), particularly in displaced and unstable fractures, were encountered. In addition, delayed union or nonunion as well as displacement, varus bending, and/or fracture of the plate were reported.

Our findings are consistent with the disappointing results mentioned above. Although union was observed in twenty-six fractures at a mean of five months (range, three to ten months), there were high rates of mechanical failure (31%) and nonunion (28%). The high rate of complications might be explained by the design of the Mennen plate. Similar to the findings reported by Liu et al.[23] and others[31,33,34], problems occurred with respect to the strength of the plate in eleven fractures, resulting in varus bending and/or fracture of the plate. The plate does not appear to be not strong enough to withstand the weight-bearing forces associated with fractures of the femur, particularly in the more unstable periprosthetic fractures classified as type II or III, according to the system of Johansson et al.[8]. However, in the type-I fractures, in which the fracture is proximal to the tip of the prosthesis, the results seem to be better as all nine type-I fractures had an uncomplicated union. In this type of fracture, the stem of the prosthesis appears to provide some stability to the fracture. The good results found in the present study and those reported in other studies of patients treated with a combination of Mennen plate fixation and revision arthroplasty seem to confirm this theory[24,27-29].

In summary, on the basis of our study and a review of the literature, we believe that the treatment of periprosthetic femoral fractures with the Mennen plate is complicated by a high rate of failure, particularly in unstable (Johansson[8] type-II and III) fractures. Although good results were found in type-I fractures and in combination with revision procedures, we do not recommend the Mennen plate for the treatment of periprosthetic femoral fractures.

Appendix

eA A table summarizing previously published articles on Mennen plate fixation of periprosthetic fractures can be found in the electronic versions of this article, on our web site at www.jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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