# Twenty-six-Year Results After Broström Procedure for Chronic Lateral Ankle Instability

S. Josh Bell,*† MD, LCDR MC USNR, Timothy S. Mologne,‡ MD, David F. Sitler,§ MD, and Jay S. Cox, MD

*From the †Department of Orthopedic Surgery, Naval Hospital, Rota, Spain, ‡Sports Medicine Center, Appleton, Wisconsin, and §Sharp Rees-Steely Medical Group, San Diego, California*

**Background:** The procedure described by Broström has been used to address chronic lateral ankle instability; the long-term results of this procedure have not been reported.

**Hypothesis:** The Broström procedure provides good results over the long term for active patients with chronic lateral ankle instability.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Thirty-one male patients (32 ankles) who underwent the Broström procedure for chronic lateral ankle instability while enrolled as students at the United States Naval Academy were identified. Each patient was mailed a questionnaire that included a functional outcome measure as described by Roos et al, a score described by Good et al, and a single-number ankle functional assessment. The mean age was 20.7 years (range, 18-23 years) at the time of operation. A functional outcome score was completed on each patient, with a mean follow-up of 26.3 years (range, 24.6-27.9 years).

**Results:** The follow-up included 22 of the 31 original patients. The mean numeric score for overall ankle function was 91.2 of 100 (standard deviation, 10.2). The foot and ankle outcome score (described by Roos et al) was 92.0 (92%; standard deviation, 12.8) averaged over 5 functional areas. Ninety-one percent of the patients described their ankle function as good or excellent using the scale devised by Good et al.

**Conclusion:** The long-term results of the Broström procedure for chronic lateral ankle instability are excellent with 26-year follow-up.

**Keywords:** ankle; ankle instability; ligament reconstruction; lateral ligaments

Lateral ankle instability is a specific complaint that occurs as a result of injury to the ligamentous complex on the lateral side of the ankle. Initially, complete ruptures of these ligaments should be treated with nonoperative therapy, as this gives good results in 80% of patients.[3,5] In patients who do not respond, surgical treatment may be pursued. Many procedures to address this chronic laxity have been described. Anatomical surgical procedures, such as one described by Broström, involve reattachment of the anatomical tissues (most common, the anterior talofibular ligament and, less common, the calcaneofibular ligament) that have been disrupted.[3,4] Nonanatomical procedures seek to further stabilize the lateral ankle by using additional tissue when native ligamentous tissue fails; this traditionally involves the sacrifice of a portion of the peroneal tendons to support the injured ligaments.[‖] Multiple reports address long-term results of nonanatomical surgical procedures for ankle instability.[1,2,14,17,21-23] Some long-term studies of nonanatomical reconstructions report maintenance of stability but at the cost of sacrifice of the peroneal tendons and the potential for nonanatomical forces across the ankle joint causing future ankle degeneration.[22]

We evaluated the long-term results of an anatomical repair of the lateral ankle ligaments in patients with chronic lateral ankle instability, using a validated functional score.

## MATERIALS AND METHODS

This study was approved by the Institutional Review Board at the Naval Medical Center, San Diego, California. Thirty-one patients (32 ankles) with lateral ankle instability who

*Address correspondence to S. Josh Bell, MD, c/o Clinical Investigation Department, Suite 5, 34800 Bob Wilson Drive, San Diego, CA 92134-1005 (e-mail: sjbell@rota.med.navy.mil).

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[‖]References 1, 2, 6, 9, 10, 14, 17, 19-23.

TABLE 1
Grading of Lateral Instability of the Ankle According to Good et al[7]

| Grade | Description |
|---|---|
| 1 | Full activity, including strenuous sports activities; no pain, swelling, or giving way |
| 2 | Occasional aching after strenuous exercise only; no giving way or feeling of apprehension |
| 3 | No giving way but some apprehension; must be careful even when walking on uneven ground |
| 4 | Recurrent instability and giving way during normal activities, with episodes of pain and swelling |

underwent the Broström procedures between 1975 and 1979 at the United States Naval Academy were identified. These patients were mailed a patient questionnaire that included a score of their ankles' function as defined by Roos, an ankle grading as described by Good (Table 1), and a simple numerical grade for ankle function.[7,16] Patients were excluded from the study if additional surgery was performed on the same ankle or if a major injury occurred to the operated ankle after the Broström procedure. Major injury included fracture or tendon rupture.

## TECHNIQUE

The patients included in this study had complaints of lateral ankle instability that had failed to improve with a nonoperative rehabilitation program involving proprioceptive training and peroneal strengthening. The surgical technique was to use a transverse lateral incision at the level of the distal fibula with identification of the anterior talofibular ligament and imbrication of this ligament using nonabsorbable suture. Also, if the calcaneofibular ligament was attenuated, it was imbricated in a similar "pants-over-vest" technique (in this series, this technique was rarely performed). Patients had their ankles placed in a splint postoperatively, and they began motion and activity after a brief period of immobilization. They were allowed to return to sports after demonstrating return of strength of their ankles.

## RESULTS

The patients ranged in age from 18 to 23 years (mean age, 20.7 years) at the time of the surgery, and all were men enrolled at the United States Naval Academy (Table 2). Of the 31 patients originally identified for this study, 1 had the procedure on each ankle at separate times. The patients who were excluded included 1 patient who had died, 1 patient who became a C6 paraplegic after an accident, and 1 patient who was doing well with no instability until he had an injury that involved rupture of his peroneus longus tendon at its insertion. This case has been reported in the literature.[18] The patient was a very active runner. Three other patients were excluded because of subsequent fracture of the operated ankles. One of the patients who sustained a fracture fell from a height while rock climbing and sustained multiple bilateral lower extremity fractures. Although many other patients who were included in the study had sustained further twisting injuries or sprains to their ankles, there were 2 who reported ankle fractures. Both patients required a period of casting and were excluded. Three patients were lost to follow-up. The mean time to follow-up was 26.3 years (range, 24.6-27.9 years). From an original cohort of 31 patients with 32 ankles, this left a cohort of 22 patients with 23 ankles. Three patients were lost to follow-up, 1 was deceased, 1 was paraplegic, 3 had fractures, and 1 had a peroneal tendon rupture from its insertion.

The mean score at follow-up on a scale of 0 to 100 (Single Assessment Numeric Evaluation) was 91.8 (SD, 10.2). Fifteen patients scored their ankles as grade 1 as described by Good; 5, as grade 2; and 2, as grade 4. The mean functional outcome scores were divided into sections, as defined by Roos et al, identifying specific sections of symptoms, pain, activities of daily living, sports and recreation, and quality of life.[16] The overall mean of each of these functional areas combined was 92.7 of a possible 100. The mean for each functional level is specified in Table 3.

## DISCUSSION

Multiple techniques for the treatment of lateral ankle instability have been described in the literature. The Broström procedure is an anatomical repair of the lateral ligaments. It is used for patients who have instability after rupture of the lateral ligaments and resultant chronic instability, despite nonoperative treatment involving ankle strengthening and rehabilitation. This procedure has shown promising results in the published literature. The longest follow-up in patients with chronic lateral ankle instability that we are aware of is 64.3 months.[8] Long-term results of nonanatomical reconstructions using the peroneus brevis tendon have been reported (Evans, Watson-Jones, and Chrisman-Snook).[1,2,10,14,17,18,21-23] Many authors suggest that long-term results may be improved with an anatomical repair because of the loss of subtalar motion, sacrifice of peroneal tendons, and concern for subsequent deterioration of the result that may occur with nonanatomical repairs.[1,17,22] Long-term results of the Watson-Jones procedure have been described by Sugimoto et al,[22] with evidence of some early arthritic change shown on radiographs; however, the radiographic findings did not correlate with functional outcome. Our report has the longest follow-up for an anatomical repair for lateral ankle instability and shows promising results in an active population (active-duty military).

The functional score described by Roos has been validated as an outcome measure for ankle instability.[16] The results in this study show mean functional scores of 92 of 100 and were obtained at a mean time of 26.3 years after the procedure. This finding compares favorably with the best long-term results for nonanatomical procedures and is the longest follow-up in the literature. Sugimoto et al[22] described the results of the Watson-Jones procedure at a

TABLE 2
Scores for the Patients With Long-term Follow-up[a]

| Patient Number | Follow-up, y | SANE | Good et al Scale | Mean AOFAS Score | Comments |
|---|---|---|---|---|---|
| 1 | | | | | Lost to follow-up |
| 2 | 27.9 | 80 | 3 | 93.2 | |
| 3 | 27.7 | 60 | 2 | 80.9 | Fracture, excluded |
| 4 | 27.9 | 65 | 1 | | Did not complete AOFAS |
| 5 | 27.7 | 95 | 4 | 96.3 | |
| 6 | 27.6 | 100 | 4 | 98.9 | |
| 7 | 27.6 | 98 | 4 | 93.4 | |
| 7 | 27.4 | 98 | 4 | 93.4 | Bilateral patient |
| 8 | 27.1 | 100 | 4 | 97.8 | |
| 9 | 26.6 | 90 | 3 | 97.8 | |
| 10 | | | | | Paraplegic after accident |
| 11 | 26.4 | 95 | 4 | 100 | |
| 12 | 25.4 | 90 | 4 | 100 | |
| 13 | 26.3 | 95 | 4 | 95.9 | |
| 14 | 26.0 | 100 | 4 | 100 | |
| 15 | 26.0 | 90 | 3 | 85.1 | |
| 16 | 25.9 | 100 | 4 | 100 | |
| 17 | 25.9 | 100 | 4 | 100 | |
| 18 | 26.0 | 100 | 4 | 98.9 | |
| 19 | 25.6 | 80 | 4 | 86.9 | |
| 20 | 25.8 | 100 | 4 | 100 | |
| 21 | | | | | Lost to follow-up |
| 22 | 25.5 | 100 | 4 | 100 | |
| 23 | 25.4 | 90 | 4 | 92.3 | |
| 24 | 25.8 | 10 | 1 | 34.0 | Fracture, excluded; reports similar symptoms on nonoperated side |
| 25 | 25.4 | 70 | 1 | 47.4 | |
| 26 | 25.4 | 80 | 3 | 64.1 | |
| 27 | | | | | Lost to follow-up |
| 28 | | | | | Torn peroneal tendons, surgical repair |
| 29 | 24.7 | 95 | 4 | 97.2 | |
| 30 | 24.6 | 80 | 3 | 82.1 | Multiple lower extremity fractures, excluded |
| 31 | | | | | Deceased |

[a]SANE, Single Assessment Numeric Evaluation; AOFAS, American Orthopaedic Foot and Ankle Society.

TABLE 3
Functional Outcome Score as Described by Roos et al[16]

| Category | Mean Score | SD |
|---|---|---|
| Symptoms | 93.6 | 9.4 |
| Pain | 93.9 | 13.4 |
| Activities of daily living | 97.0 | 9.2 |
| Sport | 91.9 | 18.0 |
| Quality of life | 87.2 | 20.5 |

mean follow-up of 13 years and 8 months, with a mean ankle-hindfoot score (as described by Kitaoka et al[13]) of 90 of a possible 100. Barnum et al[1] described the results of the modified Evans procedures in patients at a mean follow-up of 12.6 years as 85% satisfactory, but they did not use a validated functional outcome score. Others have shown deterioration of results with time. Karlsson et al[11] described the deterioration of results after the Evans procedure with only 50% of patients with satisfactory results after 14-year follow-up. Karlsson et al[12] subsequently described an anatomical repair similar to the Broström procedure and reported 87% of patients having a good or excellent result at 6-year follow-up. The long-term results of nonoperative therapy for chronic ankle instability are also known. In a study by Lofvenberg et al,[15] 32 of 49 ankles (65%) still had instability at a mean of 20 years after initial diagnosis. The anatomical repair, as described by Broström in the 1960s,[3,4] has been popularized since its first description and, based on this investigation, shows promise for long-term dependability for chronic ankle instability.

The poor results in our study may be the result of ligamentous laxity, failure of the repair, or degeneration of the ankle. Without a clinical examination or radiographic data, we are unable to make a final conclusion regarding these outcomes. One of the patients who did poorly reported similar symptoms in his contralateral ankle, indicating a possible global problem of laxity.

We recognize the limitations of this study, including that there is no radiographic follow-up or clinical examination.

The radiographic data may show some degree of ankle degeneration; however, more than 90% of the patients had a good functional result at 26 years after the procedure, regardless of their radiographic results. In addition, 2 of the patients who were excluded by the design of the study because of ankle fractures may have had injuries related to continued ankle instability. If these patients' data are included in the analysis, it does not significantly change the conclusions. The mean single numeric assessment with these 2 patients included is 87.2. Even with these patients included, 84% reported their ankles as good to excellent on the scale used by Good et al.[7] An additional limitation is the naval patient population in this study; these results may not translate to all other patients. This population, however, is likely well suited to test the results of this procedure because of their active-duty military obligated service. The excellent long-term results of our study confirm previous authors' suggestions that an anatomical repair of the lateral ankle ligaments can give excellent long-term results.

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