

When is Surgery Necessary for Symptomatic Accessory Navicular in Children and Adolescents? A Retrospective Case-Cohort Study

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INTRODUCTION:

The accessory navicular (AN) is an idiopathic condition of the foot. Generally regarded as a common anatomic variant, up to 12% of the population is estimated to be affected. Most ANs remain asymptomatic and are only discovered incidentally, but children and adolescents with symptomatic AN can have remarkably reduced quality of life due to pain and activity limitation. While many respond to conservative measures, surgery is occasionally needed. In the literature, there is lack of strong evidence for which patients are less likely to respond to conservative treatment and eventually need surgery. Our purpose was to determine factors associated with failure of nonsurgical management and to assess surgical outcomes.

METHODS:

This retrospective case-cohort study included patients under age 19 years presenting at a single institution between 2000 and 2021 with symptomatic AN and treated with standard-of-care. All 298 surgical cases, indicating failed nonsurgical treatment, were identified and included during the study period. For the subcohort, 299 patients were randomly sampled from all eligible patients presenting with symptomatic AN during this time period, regardless of treatment. Exclusion criteria included any history of fracture to the affected midfoot, congenital painful foot condition except pes planus, and surgical intervention to the affected foot except treatment for AN.

Baseline characteristics were summarized for the surgical cases and subcohort and compared using bivariate analysis. Proportional hazards assumptions were checked and stratification implemented if necessary. Marginal structural proportional hazard modeling was used to estimate hazard ratios with 95% confidence intervals via inverse probability weighting for all effects. The LinYing weighting method was also used. All tests were two-sided and p-values less than 0.05 considered significant. Analyses were conducted.

RESULTS:

The 298 surgical cases failed nonsurgical management at a median of 5.2 months (IQR, 2.0 to 11.6 months). In the subcohort, 86 failures of nonsurgical management and 213 non-failures were found, constituting a 28.7% surgery rate. In both cohorts, nearly all patients played sports, with soccer, basketball, and dance or cheer in the top 3. The most common nonsurgical treatments in the failure cohort were orthotic inserts (76%), physical therapy or stretching (70%), rest or activity modification (62%), and walking boot (58%).

Univariate proportional hazard modeling found that older age ($p=0.02$) and activity limitation ($p<0.001$) at presentation, female sex ($p=0.002$), higher BMI ($p=0.01$), and AN of the right foot ($p<0.001$) were associated with an increase in the hazard of nonsurgical failure. On imaging, bone marrow edema of the accessory navicular ($p<0.001$) and body of the navicular ($p<0.001$) were also associated with nonsurgical failure, but not any radiographic measures of pes planus (talonavicular coverage angle, Meary's angle, calcaneal pitch angle) or type of AN.

Surgical interventions included excision of the AN (294/298, 99%), naviculoplasty (268/298, 90%), posterior tibial tendon advancement (184/298, 62%), and splitting/resection and repair (126/298, 42%). Nearly all of those in the surgical cohort reported improvement in pain (278/296, 94%) and were able to return to their primary sport (236/253, 93%) after surgery. The majority also experienced full resolution of their symptoms (187/281, 67%).

DISCUSSION AND CONCLUSION:

Symptomatic AN predominantly affects female athletes from soccer, dance, and basketball and led to surgery in 28.7% of our subcohort. Conservative treatment may be less successful – and therefore surgery should be considered – in older age, activity limitation at presentation, female sex, higher BMI, AN of the right foot, and bone marrow edema of the AN and body of the navicular on MRI. Pes planus did not significantly influence nonsurgical failure. Surgery is highly effective for improving pain and allowing return to sports, and the majority are able to reach complete symptom resolution.

Table 1. Summary of sports participation.

Sport	Failed non-operative management (n=298)		Sub-cohort (n=209)	
	Freq.	(%)	Freq.	(%)
Basketball	11	(4%)	15	(7%)
Basketball	66	(22%)	76	(37%)
Dance/cheer	88	(30%)	64	(31%)
Figure skating	12	(4%)	15	(7%)
Futsal	14	(5%)	14	(7%)
Golf	2	(1%)	3	(1%)
Gymnastics	38	(13%)	37	(18%)
Hockey	28	(9%)	34	(17%)
Lacrosse	35	(12%)	34	(17%)
Skating	24	(8%)	16	(8%)
Soccer	91	(31%)	110	(53%)
Sportball	25	(8%)	18	(9%)
Swimming	29	(10%)	31	(15%)
Tennis	15	(5%)	18	(9%)
Track/field	31	(10%)	24	(12%)
Volleyball	9	(3%)	15	(7%)
Wrestling	9	(3%)	1	(0%)
XC	18	(6%)	12	(6%)
Other	31	(10%)	36	(17%)

*Because patients could have participated in more than one sport, these percentages do not add to 100%.

Table 2. Unadjusted case-cohort proportional hazard models for failure of non-operative management.

Characteristic	HR	(95% CI)	P
Age at presentation (years; mean (SD))	1.09	(1.02-1.18)	0.02
Sex (% female)	0.54	(0.37-0.8)	0.002
BMI percentile (median (IQR))	1.07	(1.02-1.14)	0.01
Bilateral	1.25	(0.92-1.69)	0.16
Side (% right)	1.80	(1.32-2.46)	<0.001
AN symptoms			
Foot swelling	1.15	(0.82-1.62)	0.42
Activity limitation	3.08	(2.25-4.21)	<0.001
Sport participation	0.91	(0.53-1.56)	0.72
Radiographic measure			
Accessory Navicular type			
Type 1	1.00	referent	
Type 2	1.14	(0.79-1.63)	0.49
Type 3	0.72	(0.41-1.27)	0.26
Skeletal maturity			
Stage 2	1.00	referent	
Stage 3	0.89	(0-1.71)	0.73
Stage 4	1.14	(0.63-2.07)	0.66
Stage 5	1.27	(0.71-2.3)	0.42
Radiographic characteristics			
Talonavicular coverage angle	1.00	(0.97-1.02)	0.68
Meary's angle	0.98	(0.95-1.01)	0.24
Calcaneal pitch angle	1.01	(0.95-1.07)	0.72
MRI characteristics			
MRI bone marrow edema	1.08	(0.45-2.64)	0.86
Bone marrow edema in accessory navicular	2.34	(1.66-3.29)	<0.001
Bone marrow edema in body of the navicular	2.65	(1.46-2.87)	<0.001

HR, hazard ratio, CI, confidence interval. Bolded variables significant at the 5% level.

Table 3. Summary of non-operative treatments and surgical interventions for the non-operative failure cohort (N=298).

Previous non-operative treatment	Freq.	(%)
Cast	59	(20%)
Physical therapy/stretching	207	(70%)
Ankle brace	40	(13%)
Rest/ activity modification	227	(76%)
Oral pain medication	185	(62%)
Topicals	112	(38%)
Ice/heat	33	(11%)
Corticosteroid injection	77	(26%)
Walking boot	10	(3%)
Massage	172	(58%)
Acupuncture	4	(1%)
Nerve therapy	7	(2%)
Other	1	(0%)
Other	137	(46%)
Surgical intervention		
Posterior tibial tendon advancement	184	(62%)
Posterior tibial tendon splitting/resection and repair	126	(42%)
Excision of accessory navicular	294	(99%)
Navicularophary (contouring of the medial aspect of the navicular)	208	(69%)
Other	12	(4%)

Table 4. Outcomes for the non-operative failure cohort.

Outcome	Freq.	(%)
Improvement in pain (N=298)	278	(94%)
Full resolution of symptoms (N=283)	187	(67%)
Of those who participated in sports (N=253)		
Return to primary sport	236	(93%)
Play different sport(s) because had to stop primary sport(s)	5	(2%)
Unable to return to sports, but still able to complete daily activities	8	(3%)
Unknown	4	(2%)
Of those who did not participate in sports (N=26)		
Able to complete daily activities without limitations	21	(79%)
Mild persistent symptoms but still able to complete daily activities	6	(21%)
Other	1	(4%)