Heightened Revision Risk: Ankle Instability Surgery in Patients with Ehlers-Danlos Syndrome/Hypermobility Spectrum Disorder

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INTRODUCTION:

Joint instability is a significant clinical manifestation in Ehlers-Danlos Syndrome (EDS) and hypermobility spectrum disorder (HSD), heritable connective tissue disorders characterized by defects in collagen formation. These conditions lead to joint hypermobility and instability, significantly limiting daily activities for patients with HSD and EDS, who also suffer from issues with walking, balance, and a reduced sense of joint proprioception. The surgical outcomes for these populations remain poorly characterized compared to non-hypermobile individuals. Due to altered biomechanical properties of connective tissues in EDS/HSD, surgical procedures carry an increased risk of complications and failure. Connective tissue disorders like EDS/HSD are linked to revision rates as high as 35% in small cohort studies, though robust comparative data are lacking. No studies have directly compared surgical failure rates between EDS/HSD patients and matched controls, leaving surgeons without evidence to guide risk stratification. The purpose of this study is to investigate the rates of revision surgery between patients with EDS/HSD and matched controls following ankle surgery. We hypothesize that patients with a preoperative diagnosis of EDS/HSD will experience higher rates of revision surgeries for ankle instability compared to those without such diagnoses.

METHODS: A retrospective cohort study was conducted using the PearlDiver Mariner 170 Database. Patients undergoing ankle ligament repair procedures were identified using CPT codes. The experimental cohort included patients with EDS/HSD with at least two years of follow-up data, excluding other connective tissue disorders and confounding conditions. Propensity score matching was used to create a matched control group. The primary outcome was the rate of revision ankle ligament repair within 2 years and 5 years. The secondary outcome was the effect of patient risk factors associated with revision surgery. Revision rates were compared between cohorts using multivariable logistic regression. Statistical significance was set at $p < 0.05$.

RESULTS:

The 2-year cohort included 805 patients with EDS/HSD and 805 matched controls, while the 5-year cohort consisted of 480 patients in each group. Procedures primarily involved modified Brostrom repair, lateral ankle ligament reconstruction, and arthroscopic-assisted repairs. Patients with EDS/HSD had significantly higher revision rates at two years (13.8% vs. 6.3%) and five years (19.4% vs. 7.3%) ($p < 0.0001$). Multivariate analysis identified EDS/HSD as an independent risk factor for revision surgery, with adjusted odds ratios of 2.41 at two years and 3.11 at five years ($p < 0.0001$).

DISCUSSION AND CONCLUSION:

This study highlights the significant challenges in the surgical management of ankle instability in patients with EDS and HSD. The risk of surgical failure persists and intensifies over time, with a 3.1-fold increase in revision surgery rates at five years postoperatively compared to matched controls. These findings emphasize the need for specialized surgical approaches and comprehensive perioperative care to address the unique risks and complications in this population.

Table 1. Demographic Characteristics of Included Patients

Minimum 2-year follow-up

	Ankle Surgery Patients	EDS/HSD	Control	p-value	Matched EDS/HSD	Matched Control
Count	87,828	827	87,001		805	805
Age (Mean ± SD)	41.2 ± 16.3	30.5 ± 12.6	41.3 ± 16.3	**<0.0001**	30.7 ± 12.6	30.7 ± 12.6
Gender (%F)	65.0%	82.9%	66.7%	**<0.0001**	82.9%	82.9%
CCI	0.81 ± 1.34	0.95 ± 1.17	0.81 ± 1.34	**0.0044**	0.88 ± 1.03	0.88 ± 1.03
Diabetes	21.0%	14.9%	21.0%	**<0.0001**	15.7%	15.7%
Obesity	44.2%	41.4%	44.2%	**0.0057**	41.4%	41.4%
Tobacco Use	34.4%	27.2%	34.5%	**<0.0001**	27.5%	27.5%

Minimum 5-Year follow-up

	Ankle Surgery Patients	EDS/HSD	Control	p-value	Matched EDS/HSD	Matched Control
Count	56,517	495	56,022		480	480
Age (Mean ± SD)	49.6 ± 13.5	37.8 ± 12.4	49.7 ± 13.5	**<0.0001**	37.9 ± 12.3	37.9 ± 12.3
Gender (%F)	66.1%	82.3%	65.8%	**<0.0001**	82.7%	82.7%
CCI	0.68 ± 1.38	0.77 ± 1.04	0.68 ± 1.78	0.4765	0.66 ± 0.87	0.66 ± 0.87
Diabetes	21.8%	12.3%	21.9%	**<0.0001**	10.8%	10.8%
Obesity	46.2%	39.8%	46.5%	**0.0014**	39.8%	39.8%
Tobacco Use	34.1%	27.2%	34.4%	**0.0013**	27.5%	27.5%

*p-value: chi-square tests for differences of proportions, t-tests for differences of continuous variables
**Bolded text indicates statistical significance
Ehlers-Danlos Syndrome (EDS), Hypermobility Spectrum Disorder (HSD), Standard Deviation (SD), Charlson Comorbidity Index (CCI)

Table 2. Rates of Revisions Surgery After Initial Ankle Instability Procedure

Minimum 2-Year Follow-up

	Ankle Surgery Patients	EDS/HSD	Control	p-value	Matched EDS/HSD	Matched Control	p-value
Count	87,828	827	87,001		805	805	
Revision Surgery	5,747 (6.5%)	113 (13.9%)	5,632 (6.5%)	**<0.0001**	111 (13.8%)	51 (6.3%)	**<0.0001**

Minimum 5-Year Follow-up

	Ankle Surgery Patients	EDS/HSD	Control	p-value	Matched EDS/HSD	Matched Control	p-value
Count	56,517	495	56,022		480	480	
Revision Surgery	3,387 (5.9%)	99 (20.0%)	3,288 (5.7%)	**<0.0001**	93 (19.4%)	35 (7.3%)	**<0.0001**

*p-value: chi-square tests for differences of proportions, t-tests for differences of continuous variables
**Bolded text indicates statistical significance
Ehlers-Danlos Syndrome (EDS), Hypermobility Spectrum Disorder (HSD)

Table 3. Multiple Variable Regression Analysis for Revision Surgery

Minimum 2-Year Follow-up

	Odds Ratio [CI]	p-value
EDS/HSD	2.41 [1.71-3.45]	**<0.0001**
Age	0.86 [0.85-0.88]	**<0.0001**
Male Gender	1.09 [0.93-1.03]	0.7864
CCI	1.09 [0.92-1.29]	0.3225
Diabetes	1.37 [0.83-2.20]	0.2097
Obesity	1.62 [1.33-2.31]	**0.0086**
Tobacco Use	1.74 [1.21-2.50]	**0.0027**

Minimum 5-Year Follow-up

	Odds Ratio [CI]	p-value
EDS/HSD	3.11 [2.07-4.77]	**<0.0001**
Age	0.97 [0.96-0.98]	**0.0040**
Male Gender	0.68 [0.24-1.45]	0.3170
CCI	1.06 [0.86-1.35]	0.5865
Diabetes	1.45 [0.77-2.55]	0.2423
Obesity	1.49 [0.94-2.39]	0.0790
Tobacco Use	1.31 [0.86-1.99]	0.2001

*p-value: logistic regression tests for the relationship between variables
**Bolded text indicates statistical significance
Ehlers-Danlos Syndrome (EDS), Hypermobility Spectrum Disorder (HSD), Charlson Comorbidity Index (CCI), Confidence Interval (CI)