Published in final edited form as:
J Hand Surg Am. 2013 November ; 38(11): 2138–2143. doi:10.1016/j.jhsa.2013.08.109.

Ligamentous Hyperlaxity and Dorsal Wrist Ganglions

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Work completed at Washington University in St Louis

Abstract

Purpose—To determine if symptomatic dorsal wrist ganglions are associated with generalized ligamentous hyperlaxity.

Methods—Ninety-six patients (61 females) presenting to hand surgeons for a symptomatic dorsal wrist ganglions were prospectively enrolled in this case-control investigation. Beighton scores were calculated to quantify generalized ligamentous laxity in each patient, and a scaphoid shift test (scapholunate capsuloligamentous laxity evaluation) was performed. A positive scaphoid shift test was defined by both pain and a palpable clunk. Ninety-six individuals without ganglions were then enrolled to form an age and sex frequency-matched control cohort. The control group was similarly assessed for Beighton score and scaphoid shift test. Binary logistic regression was performed to assess the association of ganglions with generalized ligamentous hyperlaxity (Beighton score ≥4) while accounting for effects of age and sex.

Results—Patients with symptomatic dorsal wrist ganglions demonstrated significantly increased rates of generalized ligamentous hyperlaxity. Among those with ganglions, 27 of 96 (28%) patients exhibited generalized ligamentous hyperlaxity, compared to 12 of the 96 (13%) age and sex-matched individuals in the control group. Patients with symptomatic dorsal wrist ganglions were also significantly more likely to demonstrate localized scapholunate hyperlaxity with a positive scaphoid shift test (25% positive scaphoid shift test with ganglions vs 1% in controls). In logistic modeling, patients with dorsal wrist ganglions had 2.9 (95% CI 1.3-6.2) times greater odds of generalized ligamentous hyperlaxity compared to patients without a dorsal wrist ganglion after accounting for patient age and sex.

Discussion—Symptomatic dorsal wrist ganglions were associated with both generalized ligamentous hyperlaxity and a positive scaphoid shift test. Although an association between wrist ganglions and ligamentous hyperlaxity does not prove causation, the possibility of the same underlying pathological entity causing both can be envisioned (i.e., abnormal formation or organization of dense regular connective tissue).

Type of study/level of evidence—Prognostic III

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Keywords

Beighton; Ganglion; Hyperlaxity; Wrist

INTRODUCTION

Ganglions represent 60% of all hand and wrist masses and are a frequent presenting complaint in hand surgery clinics. Dorsal wrist ganglions are the most common ganglions seen in the upper extremity and typically arise from the scapholunate interval.(1) These cysts are particularly common in young adults and are 3 times more common in women than men.(2) Despite their high prevalence, the cause of dorsal wrist ganglions is not well understood. These cysts can arise following trauma but often are considered idiopathic without any clear inciting event.

Generalized ligamentous hyperlaxity has been shown to predispose an individual to a number of orthopedic ailments, including ACL tears, recurrent ankle sprains, shoulder dislocations, and basal thumb joint osteoarthritis.(3, 4) Hyperlaxity has been quantified using the Beighton score.(5) Compared to the general adult population, young females have higher rates of generalized ligamentous hyperlaxity. In one study of female high school athletes, the rate of generalized ligamentous hyperlaxity was 22%, compared to 6% of male high school athletes.(6)The suggestion that dorsal wrist ganglions are particularly common in young women (teenage to young adult) raises the possibility that ganglions are associated with ligamentous hyperlaxity.(7)

The purpose of this investigation was to determine the rate of generalized ligamentous hyperlaxity in patients with symptomatic dorsal wrist ganglions compared to an age and sex-matched control population. Our primary hypothesis was that patients with ganglions would demonstrate greater rates of ligamentous hyperlaxity. The null hypothesis was that the rates of ligamentous hyperlaxity would remain similar between the groups.

METHODS

After obtaining approval from our institutional review board, 96 consecutive patients who presented to 1 of 5 hand surgeon at our institution with a symptomatic dorsal wrist ganglion were prospectively enrolled from March 2011 to February 2013. The diagnosis of dorsal wrist ganglion was made by a fellowship-trained attending hand surgeon based on history and physical examination. A symptomatic dorsal wrist ganglion was defined as any ganglion causing pain or discomfort in the affected wrist. If diagnostic uncertainty existed, the diagnosis was verified with cyst aspiration, magnetic resonance imaging study, or ultrasound.(8)

All patients presenting with a symptomatic dorsal wrist ganglion (palpable - 84 or occult - 12) were eligible for the study. There were no selection criteria based on age or sex. Exclusion criteria were a lack of English proficiency or mental status prohibiting study consent. All patients who were offered enrollment agreed to participate. Patients were offered participation and provided written informed consent in the office following

completion of the clinical evaluation by their attending surgeon. Demographic information, including age and sex, was recorded for each participant. A scaphoid shift test, as described by Watson et al., was performed on the symptomatic wrist (9). The patient's generalized ligamentous laxity was assessed by examination for those elements required for the Beighton score. The 4 patients with dorsal ganglions arising from areas other than the dorsal scapholunate ligament (i.e., dorsal lunotriquetral ligament, central carpometacarpal joint, distal radio-ulnar joint, midcarpal space) were excluded from contributing scaphoid shift test data. Beighton scores were calculated according to accepted guidelines specified in Table 1. Wrist radiographs were not routinely taken, unless the patient reported a history of prior trauma, in accordance with our division's clinical policy.

After enrolling the cohort of patients with symptomatic dorsal wrist ganglions, we enrolled a healthy age (±1 year) and sex frequency-matched cohort to serve as controls. Controls verbally denied history of wrist ganglions, and the absence of current clinically evident ganglions was confirmed by physical examination. These patients were enrolled using an identical protocol. A scaphoid shift test was performed on both wrists in this cohort in addition to examination necessary to determine the Beighton score.

Generalized hyperlaxity was defined as a Beighton score of ≥4, consistent with previous publications.(10, 11) The scaphoid shift test was considered positive only if both pain and a palpable clunk were present during testing.

Data Analysis

We planned this case-control investigation based on a sample size estimation to detect an absolute increase in generalized hyperlaxity of 20% between the groups. Based on published data in both adult and pediatric populations, we assumed the probability of hyperlaxity among controls being 0.1.(6, 12, 13). We needed to study 82 case patients and 82 control patients to be able to reject the null hypothesis that the hyperlaxity rates for case and controls were equal with probability (power) of 0.9 and an alpha of 0.05.

Descriptive statistics (mean±SD or frequency) were calculated to demonstrate the similarity of the 2 patient groups. Chi-square analysis was performed to determine the relationship between hyperlaxity and the presence of a dorsal wrist ganglion. A similar analysis was performed by the Fisher exact test to determine the relationship for sex. A Student *t*-test was used to determine a difference in the mean age for patients with generalized hyperlaxity. These variables were then entered into a binary logistic model to determine which factors would remain associated with generalized hyperlaxity accounting for all other variables. Model explanatory power and fit was assessed using the c-statistic and confirmed with a nonsignificant Hosmer-Lemeshow lack-of-fit test. All 3 possible 2×2 interactions between factors (sex, age, presence of ganglion) were also considered. An alpha level of 0.05 was used for all significance tests.

RESULTS

A total of 192 individuals were enrolled (96 patients had symptomatic dorsal wrist ganglions and 96 age- and sex-matched controls). The average age of the dorsal wrist ganglion group

was 31 years old (range 10-69 years) and the average age of the control group was 30 years old (range 10-69 years). There were 61 female (64%) subjects in each group. Among patients diagnosed with a dorsal wrist ganglion, 21 underwent aspiration for diagnosis and possibly for treatment. For diagnostic confirmation, an additional 10 patients underwent ultrasound, and 12 had magnetic resonance imaging. Forty-nine patients chose to have an excision of their ganglion. In these 49 patients, 4 ganglions appeared to originate from an intercarpal space other than the scapholunate interval. The remainder originated from the scapholunate interval as expected. All scapholunate ligaments were noted to be intact.

The distribution of Beighton scores for both the dorsal wrist ganglion cohort and the control cohort is presented in Table 2 The increased prevalence of hyperlaxity in the dorsal wrist ganglion group compared to the control group was statistically significant (P=0.007). Univariate analysis further confirmed that participants demonstrating generalized ligamentous hyperlaxity were significantly younger (difference 6.6 years, P=0.002). Furthermore, stratification of the data by sex demonstrated an association between hyperlaxity and the presence of a dorsal wrist ganglion cyst for males (P=0.045).

Logistic modeling to predict generalized hyperlaxity produced an overall model that was significant (Wald χ^2=19.60, df=3, P<0.001), with a c-statistic of 0.72. Significant independent predictors of generalized hyperlaxity (accounting for each of the other variables) included female sex, younger age, and the presence of a dorsal wrist ganglion (Table 3). None of the potential interactions contributed to the final model.

Twenty-three of 92 patients (25%) in the dorsal wrist ganglion cohort had a positive scaphoid shift test. One patient in the control cohort had a positive scaphoid shift test. This difference was statistically significant (P<0.01). Additional patients in the dorsal wrist ganglion cohort had provocative findings during the scaphoid shift test, including a painless clunk in 14 patients (15%) and pain without clunking during testing in 11 patients (11%). No control patients demonstrated painless clunk or pain without clunking during scaphoid shift testing. There was no difference in the rates of generalized ligamentous hyperlaxity among patients with provocative findings during the scaphoid shift test and those with a negative scaphoid shift test (P=0.53).

DISCUSSION

Our study demonstrated an association between generalized ligamentous hyperlaxity and dorsal wrist ganglions. This association remained significant even when accounting for sex and patient age. While further study is needed to determine if this association represents a causative relationship, generalized ligamentous hyperlaxity may play a role in the development of atraumatic dorsal wrist ganglions.

The cause of dorsal wrist ganglions has been elusive despite a variety of hypotheses and investigations. One controversial theory posited a traumatic origin.(14, 15) Recent arthroscopic examinations have linked wrist ganglions to intra-articular abnormalities including scapholunate ligament and triangular fibrocartilage abnormalities.(16-20) Related to this theory, ganglions have been attributed to either chronic or acute damage to a portion

of the scapholunate ligament or the joint capsule leading to tissue expansion with fluid accumulation (21, 22) However, the lack of a synovial lining in ganglions would argue against this mechanism.(23) In a modified theory of trauma weakening the joint capsule, chronic or acute damage may lead to a capsular defect. Synovial fluid could travel out of the joint space and interact with the peri-articular tissue, resulting in the formation of the dorsal wrist ganglion cyst wall and its gelatinous fluid.(23) However, no correlation connecting these events has been shown.

Additional distinct explanations for the formation of dorsal wrist ganglions have linked the cysts to inflammatory responses, but this is refuted by histological studies.(24, 25) Stress or injury to the extracapsular tissues has also been of interest as this may result in mucoid degeneration of the extra-articular connective tissue preceding the formation of any actual cyst. Alternatively, such tissue stress has been hypothesized to cause mucin secretion by mesenchymal cells of surrounding tissue.(2, 26-28)

We propose an association of symptomatic dorsal wrist ganglions with both generalized hyperlaxity, as demonstrated by Beighton score, and local capsuloligamentous hyperlaxity, as demonstrated by the scaphoid shift test. The presence of a positive scaphoid shift test in the absence of frank scapholunate diastasis represents localized capsuloligamentous hyperlaxity, allowing the scaphoid to subluxate out of the scaphoid fossa during provocative testing. Easterling et al. found that asymptomatic controls with a palpable clunk during scaphoid shift testing were also more likely to have generalized ligamentous hyperlaxity, further supporting the role of scaphoid shift testing in the evaluation of ligamentous hyperlaxity.(29)

The association with generalized ligamentous hyperlaxity may argue against a purely traumatic origin. However, multiple studies have linked generalized ligamentous hyperlaxity to musculoskeletal abnormalities such as recurrent ankle instability, multidirectional glenohumeral instability, and basal joint osteoarthritis.(3) A prospective study investigating a cohort of 675 17-year-old males linked generalized ligamentous hyperlaxity with a greater occurrence of musculoligamentous (e.g., ankle sprain, knee pain, muscle strain) injuries throughout the body.(30) Fewer studies have associated localized ligamentous hyperlaxity with specific injuries. One such study linked both generalized and localized hyperlaxity to a higher risk of anterior cruciate ligament tears in female soccer players.(31) Further studies may elucidate other relationships between localized hyperlaxity and specific musculoskeletal injuries to help us better understand the cause of those injuries.

The prevalence of generalized ligamentous hyperlaxity in our control cohort is comparable with the results of prior epidemiological studies. A study of healthy adult blood bank donors found a Beighton score of ≥4 in 31 of 637 (5%) individuals.(32) Two other studies examined the rates of hyperlaxity syndrome (defined as a Beighton score ≥4 with associated musculoskeletal complaints) in an adult population. The first was conducted among patients referred to a rheumatology clinic, and the second based on a large epidemiology survey in New Zealand, showed a prevalence of 5.7% and 5.2%, respectively.(12, 13) We included both children and adults in our study, so a 12% prevalence, slightly higher than the 5% prevalence seen in previous studies of adult populations, was expected.(12, 13, 32) Also due

to the inclusion of both children and adults, our prevalence rates were lower than previous studies in exclusively pediatric populations reporting overall hyperlaxity rates of 13% (22% in females).(6) The development of an age- and sex-matched control cohort was therefore important to the validity of our study, since relying on historical data alone would possibly not have given an accurate representation of our ganglion cohort.

Our study has several limitations. Without routine radiographs, we cannot comment on rates of radiographically evident scapholunate diastasis or instability. The Beighton criteria, although validated by prior studies, may not perfectly measure a particular individual's generalized ligamentous hyperlaxity. The absolute increase in hyperlaxity identified between patients with ganglions and control subjects was less than we had estimated as a clinically relevant difference when calculating the desired sample size for this study (16% vs 20%). Despite a less robust effect than anticipated, we believe our finding is relevant and did represent a more than doubling in the prevalence of hyperlaxity between patients with ganglions and controls. Additionally, our study population examined patients presenting for treatment of dorsal wrist ganglions which does not necessarily ensure a homogenous population as dorsal ganglions were found to arise from various locations. Finally, we cannot presume that our data generalize to patients with volar wrist ganglions or to individuals with asymptomatic dorsal wrist ganglions.

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Table 1

The examination and scoring for the Beighton assessment of generalized hyperlaxity.*

Beighton Score	
Passive thumb apposition to ipsilateral volar forearm	L thumb touches forearm – 1 point R thumb touches forearm – 1 point
Passive hyperextension of 5th MCP joint	L 5th MCP hyperextension > 90° - 1 point R 5th MCP hyperextension > 90° - 1 point
Elbow hyperextension	L elbow hyperextension > 10° - 1 point R elbow hyperextension > 10° - 1 point
Knee hyperextension	L knee hyperextension > 10° - 1 point R knee hyperextension > 10° - 1 point
Palms towards floor with knees extended	Both palms touch floor – 1 point
Total	*9 possible points*

* ≥4 points total needed to be considered positive for generalized hyper-laxity

Table 2

Distribution of Beighton scores according to patient group.

Beighton Score	Ganglion Cases		Controls*	
	N	%	N	%
0-3	69	72%	84	88%
4-9	27	28%	12	13%

*Percentages sum to 101% due to rounding.

Table 3

Variables in the final logistic model.

Variable	Wald ÷²	â	Odds Ratio	95% CI
Presence of a ganglion	7.6	1.10	3.0	1.4-6.5
Female sex	4.2	0.88	2.4	1.0-5.6
Patient age (in years)	8.3	−0.05	0.96	0.93-0.99