Knee Joint Laxity in a Native Canadian Indian Population

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ABSTRACT

Background: Clinical observation of increased laxity has been noted in native Canadians. Comparative studies support the possible relationship between joint hypermobility and the development of osteoarthritis or other joint ailments. If joint laxity predisposes to osteoarthritis, there may be far-reaching consequences to the general Native population.

Methods: A cohort of 52 Native Canadians (NC) and 52 non-Native Canadians (NNC) were evaluated for knee laxity. All patients had no prior history of knee injury or complaints of symptoms related to knee pathology at the time of the examination. Bilateral knee examination was performed. Objective laxity was measured using the KT-1000 tensiometer. Subjective findings were also recorded.

Results: Comparison for instability between the groups (NC and NNC) revealed that the NC group had significantly greater laxity on both right and left sides for all knee ligament grading ($p \leq 0.0001$). The values for displacement during KT-1000 measurements were significantly greater in the NC group for all forces ($p \leq 0.0001$). Presence of all the following were also significantly greater in the NC group: pivot shift ($p \leq 0.001$); medial and lateral collateral ligament opening ($p \leq 0.001$); posterior cruciate drawer test ($p \leq 0.001$).

Interpretation: This prospective matched cohort reveals that there is a significant joint hypermobility in this Native Canadian population.

MeSH terms: Joint hypermobility; Native population; osteoarthritis; prospective cohort

Case studies of patients with benign joint hypermobility syndrome suggest both a tendency toward osteopenia and an association with premature osteoarthritis (OA).¹⁻¹¹ Some data from comparative studies support the possible association between joint hypermobility and the development of articular complaints.^{4,6,11} It was noted, in clinical experience, that the Native Canadian population seen in our institution had increased joint laxity in all age groups. A non-controlled study has previously indicated that there may be increased joint laxity in Native Americans.¹² It is well established that disabilities are under-diagnosed as well as under-treated in the Native Canadian population as a whole,^{13,14} although this may not be true in every treatment centre. If joint laxity predisposes to osteoarthritis, there may be far-reaching consequences to the general Native population. The northern Native population still reveres the hunter-gatherer, who has an exalted elder status. There is still a dependency on traditional food gathering in this population. Progressive limitations to mobility may decrease the ability of the tribe to gather food in a traditional sense. Predisposition to osteoarthritis and other joint ailments may have ramifications to the Native population in that this tendency has not been reported and may reflect treatment bias for this group. This current study evaluated whether the clinical sense that there was a tendency to joint laxity in the Native Canadian population in northern Canada was actually true. A group of Cree patients without knee pathology was compared to a group of non-Native patients without knee pathology. Comparison was performed between these two groups for knee joint laxity, symptoms and physical examination differences.

MATERIALS AND METHODS

A cohort of 52 Native Canadians (NC) and 52 non-Native Canadians (NNC) were evaluated for knee laxity. No patients were included in this study who fit the criteria of hypermobility syndrome (passive thumb apposition to touch the forearm; passive little finger hyperextension of more than 90 degrees; elbow hyperextension of more than 10 degrees; knee hyperextension of more than 10 degrees; forward flexion of the trunk with the knees straight

La traduction du résumé se trouve à la fin de l'article.

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and the palms of the hands resting flat on the floor).¹⁵ Patients were matched for sex. All patients had no prior history of knee injury and had no complaints of symptoms related to knee pathology, instability or other, at the time of the examination. The same examiner performed all measurements and the physical examination in order to ensure reproducible results. Bilateral knee examination was performed. Objective laxity was measured using the KT 1000 tensiometer.^{16,17} The tensiometer was employed using three settings: 15 lbs pressure, 20 lbs pressure and maximal tension manually. Maximal displacement was recorded. Range of motion of each knee was measured with a large goniometer (calculated error in measurement of 5 degrees). A Lachman grade was recorded. Lachman grade of anterior cruciate ligament integrity is a common tool¹⁸ used by orthopedic surgeons to divide the laxity of the knee for anterior translation into three discrete categories. Grade 1 refers to slight translation, grade 2 refers to gross translation of the knee with a definite endpoint, and grade 3 is gross translation of the knee without an endpoint. A normal patient has no movement (Grade 0). This scale is used in cruciate ligament injury to signify the degree of injury or laxity. This test is the most sensitive clinical indicator of knee laxity (98.6% true positive¹⁹). Inter- and intra-observer reliability is about 0.60 and 70% for negative tests.²⁰ Presence of pivot shift, LCL (lateral collateral ligament), MCL (medial collateral ligament), PCL (posterior cruciate ligament) or valgus / varus instability was tested. Pivot shift is another gross examination for knee translation used commonly by orthopedic surgeons.¹⁸ Patients with laxity or hypermobility of the knee may have a positive pivot shift test and, theoretically, there should be a negative pivot shift test in a normal knee. Questions pertaining to knee instability were also asked.

Statistical analysis

Analyses were done using the Statistical Analysis System (SAS), version 8.02 (Cary, NC, USA). Hypothesis tests with $\alpha = 0.05$ were employed to compare knee joint hypermobility in the Native Canadian vs. non-Native Canadian population. Statistical differences in the categorical variables between Native and non-Native

TABLE I
Basic Demographics of Both Groups

	Native Canadian	Non-Native Canadian
Number	52	52
Sex (M/F)	37/15	37/15
Age (Standard Deviation)	43.8 (16.6)	42.9 (14.6)

TABLE II
Total Number of Patients with Recorded Categorical Lachman Grades

Group	Right Anterior Cruciate Ligament-Lachman Grade*			Left Anterior Cruciate Ligament-Lachman Grade		
	1	2	3	1	2	3
Native Canadian	18	31	3	20	31	1
Non-Native Canadian	50	2	0	50	2	0

* Lachman Grade – Degree of laxity of the Anterior Cruciate Ligament during physical examination: grade 1 – slight laxity, grade 2 – gross laxity with solid endpoint, grade 3 – gross unrestricted laxity.

Canadians were evaluated by using χ^2 tests. Fisher's exact test was performed when the minimum estimated expected value was less than 5. Student t-tests were used to compare these two populations with regard to the continuous variables. Age and gender were identified as being possible confounders. P-values were therefore adjusted for age and sex using an ANCOVA (Analysis of Covariance) procedure for the continuous variables and a logistic regression procedure for the categorical variables. Specifically, adjusted p-values for the categorical variables were derived using exact logistic regression to account for the presence of quasi-complete separation in the data. Analyses were made separately for the right and left knee. A sample of 52 Native Canadians (NC) was selected first, comprising 37 women and 15 men. The same gender counts were used for the non-Native Canadian (NNC) sample.

RESULTS

The mean age ($\pm$ SD) was 43.8 (16.6) in the NC group and 42.9 (14.6) in the NNC group. Age was not found to be statistically different between the two groups (p-value = 0.7928). Table I shows the basic demographics of the group. No patient in either group complained of instability of either knee or symptoms related to knee pathology (giving way, locking, etc). Comparison for instability between the groups (NC and NNC) revealed that the NA group had significantly greater laxity on both right and left sides in ACL (Lachman) ($p \leq 0.0001$), PCL ($p \leq 0.0001$), LCL ($p \leq 0.0001$) and MCL ($p \leq 0.0001$) testing. The Lachman values are presented in Table II. These are given because of the

sensitivity of the test and because the values illustrate the trend seen in all tests used – an increase in laxity in the NC group.

Tables III and IV show that the differences between the NC and NNC groups with respect to all variables studied are statistically significant, each with a p-value less than 0.05.

DISCUSSION

Predisposition to treatable ailments in this population may indicate a need for more resources. In particular, patients with benign joint hypermobility syndrome suggest both a tendency toward osteopenia and an association with premature osteoarthritis.¹⁻¹¹ To our knowledge, this is the first controlled study to demonstrate increased joint laxity in Native Canadians. This conforms with findings of a previous non-controlled study.¹² Potential bias may have been introduced in this study because the lead author performed all the joint range of motion measurements. Optimally, the same allied health worker or a non-participant in the paper would have made this measurement. However, the locale of the Native examinations and the need for a clinically experienced measurer made this impossible. Although all variables tested were statistically significant, clinical relevance may not follow. Knee joint ROM was consistently greater in the NC group by a few degrees. This may have no bearing in the context of measurement error, clinical dependability or clinical importance. This test was placed in the study to determine if the knee range of motion between the two populations was similar. An increase in range may have been seen as an indicator

TABLE III

Results Obtained for Categorical Variables

Variable	Knee	Description	Native Canadian (n = 52) Count (%)	Non-Native Canadian (n = 52) Count (%)	Unadjusted p-value*	Adjusted OR (95% C.I.)‡
Pivot Shift	Right	Positive	11 (21.1)	0 (0.0)	0.00025	0.23 (0, 0.58)
	Left	Negative	41 (78.9)	52 (100.0)	0.0002	0.22 (0, 0.54)
ACL†	Right	Positive	12 (23.1)	0 (0.0)	< 0.0001†	6.77 (3.16, 20.9)§
		Negative	40 (76.9)	52 (100.0)		
		I	18 (34.6)	50 (96.1)		
	Left	II	31 (59.6)	2 (3.9)	< 0.0001†	6.02 (2.85, 18.4)§
		III	3 (5.8)	0 (0.0)		
		I	20 (38.5)	50 (96.1)		
MCL	Right	II	31 (59.6)	2 (3.9)	0.0002	4.62 (1.84, ∞) or >1.84
		III	1 (1.9)	0 (0.0)		
	Left	Yes	52 (100.0)	40 (76.9)	0.0002	4.62 (1.84, ∞) or >1.84
		No	0 (0.0)	12 (23.1)		
LCL	Right	Yes	52 (100.0)	40 (76.9)	0.0002	4.62 (1.84, ∞) or >1.84
		No	0 (0.0)	12 (23.1)		
	Left	Yes	52 (100.0)	40 (76.9)	0.0002	4.62 (1.84, ∞) or >1.84
		No	0 (0.0)	12 (23.1)		
PCL	Right	Yes	52 (100.0)	40 (76.9)	0.0002	4.62 (1.84, ∞) or >1.84
		No	0 (0.0)	12 (23.1)		
	Left	Yes	52 (100.0)	40 (76.9)	0.0002	4.62 (1.84, ∞) or >1.84
		No	0 (0.0)	12 (23.1)		

p-values adjusted for age and gender

* χ^2 test

† Fisher's exact test

‡ Exact Logistic Regression

§ p-values and OR generated for the ACL were obtained by merging levels II and III to obtain a dichotomous response

TABLE IV

Results Obtained for Continuous Variables

Variable	Knee	Native Canadian Mean (SD)	Non-Native Canadian Mean (SD)	Unadjusted p-value*	Adjusted p-value†
Range of Motion	Right	160.5 (7.7)	163.7 (6.3)	0.0244	0.0237
	Left	161.3 (5.2)	163.8 (6.3)	0.0304	0.0307
Displacement – 15 lb	Right	8.9 (3.3)	4.2 (1.3)	< 0.0001	< 0.0001
	Left	8.8 (3.2)	4.3 (1.6)	< 0.0001	< 0.0001
Displacement – 20 lb	Right	10.9 (3.7)	5.2 (1.4)	< 0.0001	< 0.0001
	Left	10.5 (3.9)	5.3 (1.6)	< 0.0001	< 0.0001
Displacement – Maximal Force	Right	12.4 (4.1)	5.8 (1.6)	< 0.0001	< 0.0001
	Left	11.9 (3.8)	6.0 (1.7)	< 0.0001	< 0.0001

p-values adjusted for age and gender

* t-test

† ANCOVA

of laxity. The size of the cohort was such that the results are just statistically significant at 3 degrees difference. Clinically, a difference of 5 or, more relevant, 10 degrees would have made the surgeon think of a difference in outcome or pathology. The highly significant differences for all other measured laxity parameters points to the gross hypermobility seen in the NC population. Obviously, a longitudinal study with optimal treatment options may be able to show if this population is indeed prone to osteoarthritis or other soft tissue disease. This study may indicate that a more careful assessment of knee symptomatology and /or access to evaluation is needed in the Native Canadian population in order to avoid missing functional problems.

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RÉSUMÉ

Contexte : La laxité ligamentaire est une condition prévalente chez les autochtones canadiens. L'hypermobilité articulaire est impliquée dans le développement de pathologies articulaires telles que l'arthrose selon certaines études cliniques. Cette population présente donc un risque plus élevé de pathologies articulaires si cette hyperlaxité est confirmée.

Méthode : Une cohorte de 52 Canadiens autochtones (CA) et une autre de 52 Canadiens non-autochtones (CNA) ont été évaluées pour la laxité ligamentaire aux genoux. Aucun patient n'avait d'antécédents de trauma aux genoux, ni de plaintes liées à une pathologie du genou au moment de l'évaluation. Nous avons procédé à un examen clinique bilatéral du genou. Nous avons mesuré la laxité ligamentaire de façon objective avec le tensiomètre KT-1000, puis effectué une évaluation subjective.

Résultats : La comparaison clinique a démontré une instabilité ligamentaire statistiquement plus significative pour tous les ligaments des genoux droit et gauche chez les Canadiens autochtones (CA) ($p \leq 0,0001$). Les résultats de déplacement avec le KT-1000 ont aussi été significativement plus élevés chez les CA pour toutes les forces testées ($p \leq 0,0001$). Les tests cliniques de stabilité ligamentaire du genou suivants ont aussi été plus fréquents chez les CA : le pivot-glisement ($p \leq 0,001$), le bâillement du ligament collatéral interne et externe ($p \leq 0,001$) et le tiroir postérieur ($p \leq 0,001$).

Interprétation : Cette étude prospective de cohorte démontre une laxité ligamentaire importante du genou chez cette population de Canadiens autochtones.

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