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Normative values of radiographic parameters in coronal plane lower limb alignment in Japanese general population ; cross-sectional study in Iwaki cohort

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Risk factors of knee osteoarthritis (KOA)

~Systemic factors~

- Aging
- Sex
- Obesity
- Inactive
- Genetic background

~Mechanical factors~

- Obesity
- Muscle weakness
- Hard labor
- Injury
- Lower limb deformity



KOA

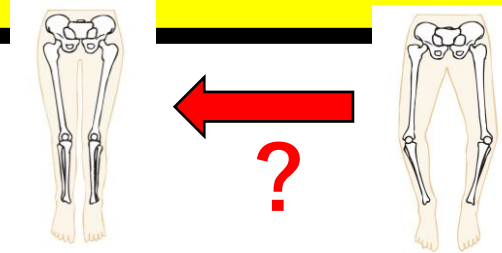
The progression of KOA induces **deformation of the lower alignment**

~Operative treatment~

- HTO
- TKA

Constitutional alignment is frequently assessed for determining the therapeutic strategy

However, there is a lack of information on constitutional alignment before KOA



Purpose

**To investigate normative values of
radiographic parameters
in coronal plane lower limb alignment
in a general Japanese population**

Materials and Methods

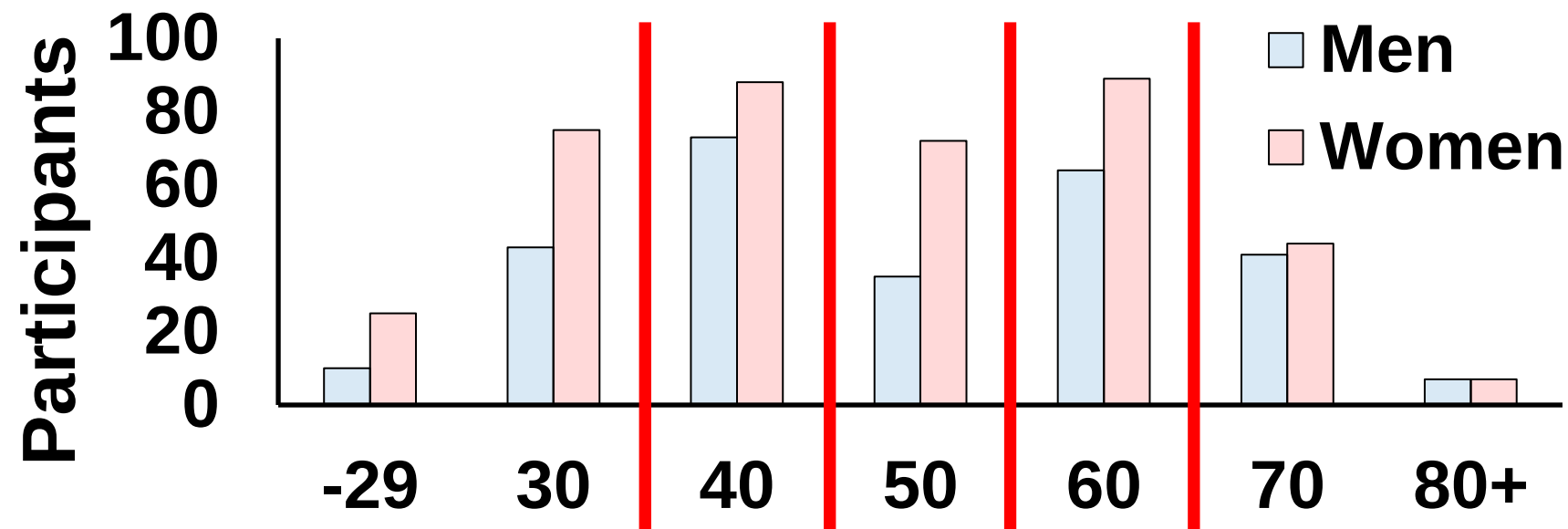
2022 Iwaki Health Promotion Project

Exclusion criteria

Surgical treatment	n=15
Fractures of lower limbs	n=29
Rheumatoid arthritis	n=5
Missing of data	n=4

n = 737 (1474 knees)

n = 673 (1346 knees)
(Men 546knees, Women 800knees)



<u>KL (knees)</u>		
0	: 510	Non-KOA
1	: 41	
2	: 328	KOA
3	: 88	
4	: 4	

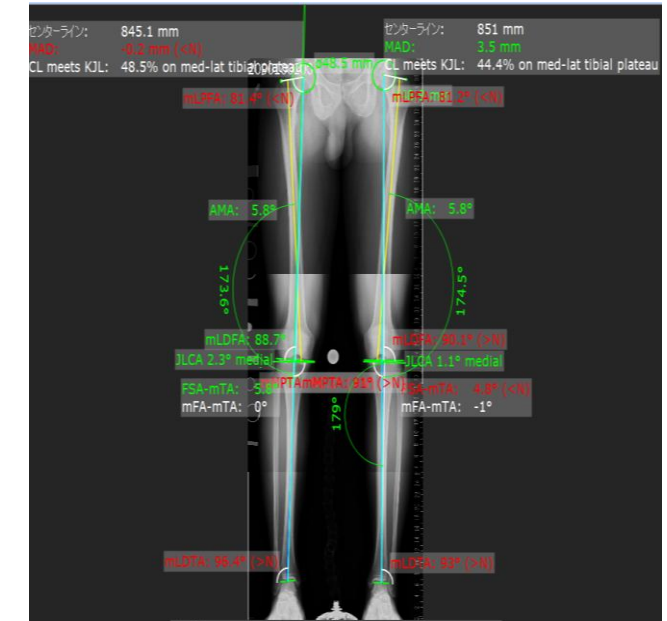
Evaluation Items

❑ Radiographic parameters (MediCAD, TOYO Corporation)

- ① HKAA : Hip knee ankle angle
- ② FTA : Femorotibial angle
- ③ LDFA : Lateral distal femoral angle
- ④ MPTA : Medial proximal tibial angle
- ⑤ JLCA : Joint line convergence angle
- ⑥ WBLR : Weight bearing line ratio

❑ Bone mineral density (DCS-600EXV, Hitachi Aloka Medical)

❑ Normative values: Mean for non-KOA group aged 18-39 years



Statistical analysis

- ✓ To compare the demographic data
- ✓ To compare the radiographic parameters
 - : Mann-Whitney U test
- ✓ To assess the correlations among radiographic parameters, age, BMI and BMD
 - : Spearman's rank correlation
- ✓ To investigate related factors
 - : Regression analysis
 - * Dependent variables : HKAA, FTA, LDFA, MPTA
 - * Independent variables : Age, Sex, BMI, BMD

Demographic data

	Total	Men	Women	P value
Participants	673	273	400	-
Age	52.6 ± 15.0	53.8 ± 15.0	51.8 ± 14.9	0.094
BMI (kg/m ²)	23.0 ± 3.3	24.0 ± 3.1	22.4 ± 3.3	<0.001

Mann-Whitney U test, $p < 0.05$

Normative values of radiographic parameters

	Total		Normative values	
	Men (546knees)	Women (800knees)	Men (98knees)	Women (169knees)
HKAA (°)	2.68 ± 2.4	1.95 ± 2.6 *	2.85 ± 2.5	1.19 ± 2.5 *
FTA (°)	176.1 ± 3.3	175.6 ± 3.5 *	176.8 ± 3.1	175.0 ± 3.2 *
LDFA (°)	87.0 ± 1.7	86.6 ± 1.9 *	86.7 ± 1.9	86.3 ± 1.6 *
MPTA (°)	85.4 ± 2.0	86.3 ± 1.9 *	84.9 ± 2.0	86.3 ± 1.9 *
JLCA (°)	1.1 ± 1.3	1.6 ± 1.5 *	1.1 ± 1.2	1.3 ± 1.4 *
WBLR (%)	36.6 ± 10.6	39.3 ± 12.0 *	35.2 ± 11.0	42.3 ± 11.6 *

Mann-Whitney U test, * : p < 0.05

Correlation among radiographic parameters, age, BMI, and BMD

Non-KOA	Men						Women					
	Age		BMI		BMD		Age		BMI		BMD	
	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value
HKAA (°)	-0.139	0.003	-0.079	0.098	0.106	0.026	0.096	0.035	-0.034	0.453	-0.054	0.024
FTA (°)	-0.220	<0.001	-0.058	0.025	0.111	0.020	-0.010	0.824	-0.042	0.358	0.020	0.659
LDFA (°)	0.004	0.927	-0.027	0.573	0.025	0.599	0.060	0.889	0.073	0.110	0.039	0.393
MPTA (°)	0.175	<0.001	0.088	0.063	-0.102	0.031	-0.073	0.110	0.061	0.179	0.092	0.043

KOA	Men						Women					
	Age		BMI		BMD		Age		BMI		BMD	
	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value
HKAA (°)	0.076	0.446	0.036	0.722	0.024	0.807	0.216	<0.001	0.050	0.377	-0.203	<0.001
FTA (°)	-0.053	0.598	0.081	0.418	0.078	0.433	0.190	<0.001	0.039	0.491	-0.240	<0.001
LDFA (°)	0.009	0.926	-0.248	0.012	-0.087	0.383	-0.061	0.274	0.016	0.772	0.021	0.710
MPTA (°)	0.034	0.737	-0.075	0.452	-0.063	0.527	-0.123	0.028	0.059	0.291	0.146	0.009

Spearman’s correlation coefficients

Related factors for radiographic parameters

Non-KOA	HKAA		FTA		LDFA		MPTA	
	B	P-value	B	P-value	B	P-value	B	P-value
Age	-0.01	0.329	-0.03	0.002	0.01	0.632	0.01	0.046
Sex	-1.09	<0.001	-0.94	0.003	-0.35	0.043	1.05	<0.001
BMI	-0.05	0.072	-0.04	0.307	-0.01	0.610	0.03	0.212
BMD	0.17	0.899	0.74	0.665	1.18	0.199	0.99	0.322
KOA	HKAA		FTA		LDFA		MPTA	
	B	P-value	B	P-value	B	P-value	B	P-value
Age	0.02	0.115	-0.009	0.579	-0.01	0.465	-0.01	0.890
Sex	-0.70	0.120	-1.21	0.042	0.10	0.762	1.03	0.002
BMI	0.03	0.417	0.07	0.169	0.01	0.896	0.001	0.963
BMD	-2.74	0.111	-7.56	<0.001	-0.46	0.716	2.22	0.080

Linear regression analysis. Dependent variables: HKAA, FTA, LDFA, and MPTA. Independent variables as age, sex, BMI and BMD.

Coronal plane lower limbs alignment in young healthy people

- ✓ Normal lower limb alignment is physiologically slight varus
- ✓ 32.2% of healthy men have a tendency to have varus alignments

	European	Japan	Total	Men	Women
HKAA (°)	1.3	2.3	2.2	2.9	1.2
LDFA (°)	88	87	87	87	86
MPTA (°)	87	86	86	85	86

4-5° varus

In this study

MPTA-based constitutional varus was more observed in men

Conclusion

- ✓ **Normative values of radiographic parameters in coronal plane lower limb alignment were different between men and women.**
- ✓ **Radiographic parameters were not correlated with age, BMI and BMD.**
- ✓ **These data might be useful to consider the etiology and therapeutic strategy for KOA.**

Reference

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