Osteaoarthritis pain prediction using X-ray features: Data from the OAI

Jorge I. Galván-Tejada[a*], S. Totterman[c], Victor Treviño[a,b], José G. Tamez-Peña[b]

[a]ITESM Campus Monterrey, Monterrey, NL, Mexico, 64849 ; [b]Dept. of Investigación e Innovación, Escuela de Medicina, ITESM, Monterrey, NL, México, 64710; [c]Qmetrics Technologies, Rochester, NY, USA

*gatejo@uaz.edu.mx

Purpose: Joint pain is a late symptomatic manifestation of knee Osteoarthritis (OA). Changes like bony osteophytes, cartilage degradation and joint space reduction may be observed in early stages of the disease. The purpose of this study is to investigate radiological features that precede the onset of knee pain, and to identify a radiological-based multivariate prognostic model of knee pain.

Methods: A case-control study was performed, where a multivariate feature selection algorithm was used to determine relationships between future joint pain and the radiological evidence of the disease.

➢ Image assessments from the Osteoarthritis Initiative (OAI):
- ▪ Central semi-quantitative scores.
- ▪ Quantitative joint space width analysis
➢ All subjects show no evidence of pain at their baseline visit, no medication for pain, and no symptomatic status.
➢ Case subjects developed pain at a subsequent time point.
➢ Control subject did not develop pain
➢ For each image assessment, three set of multivariate analyses were carried out:
- ▪ T0: Concurrent analysis of Pain
- ▪ T-1: Prognosis of pain the prior year
- ▪ T-2: Prognosis of pain two years in advance
➢ Three multivariate searches were then performed for each analysis, one using the T0, T-1 and T-2 data.
➢ Using Galgo, a multivariate feature selection strategy based on genetic algorithms 1000 predictive logistic regression models, with 5 features each were obtained
➢ Forward Selection strategy was carried out, prompting a new predictive model.
➢ Finally, the size of this model was reduced by using a Feature Elimination algorithm.

Figure 1 shows the analysis flowchart.
Table 1 shows the demographic information.

Results: Table 2 shows the features and statistical information of the T0, T-1 and T-2 predictive models.

Conclusions: The obtained models suggest that changes in early joint structure like osteophytes, and multivariate models of JSW are associated with future joint pain.
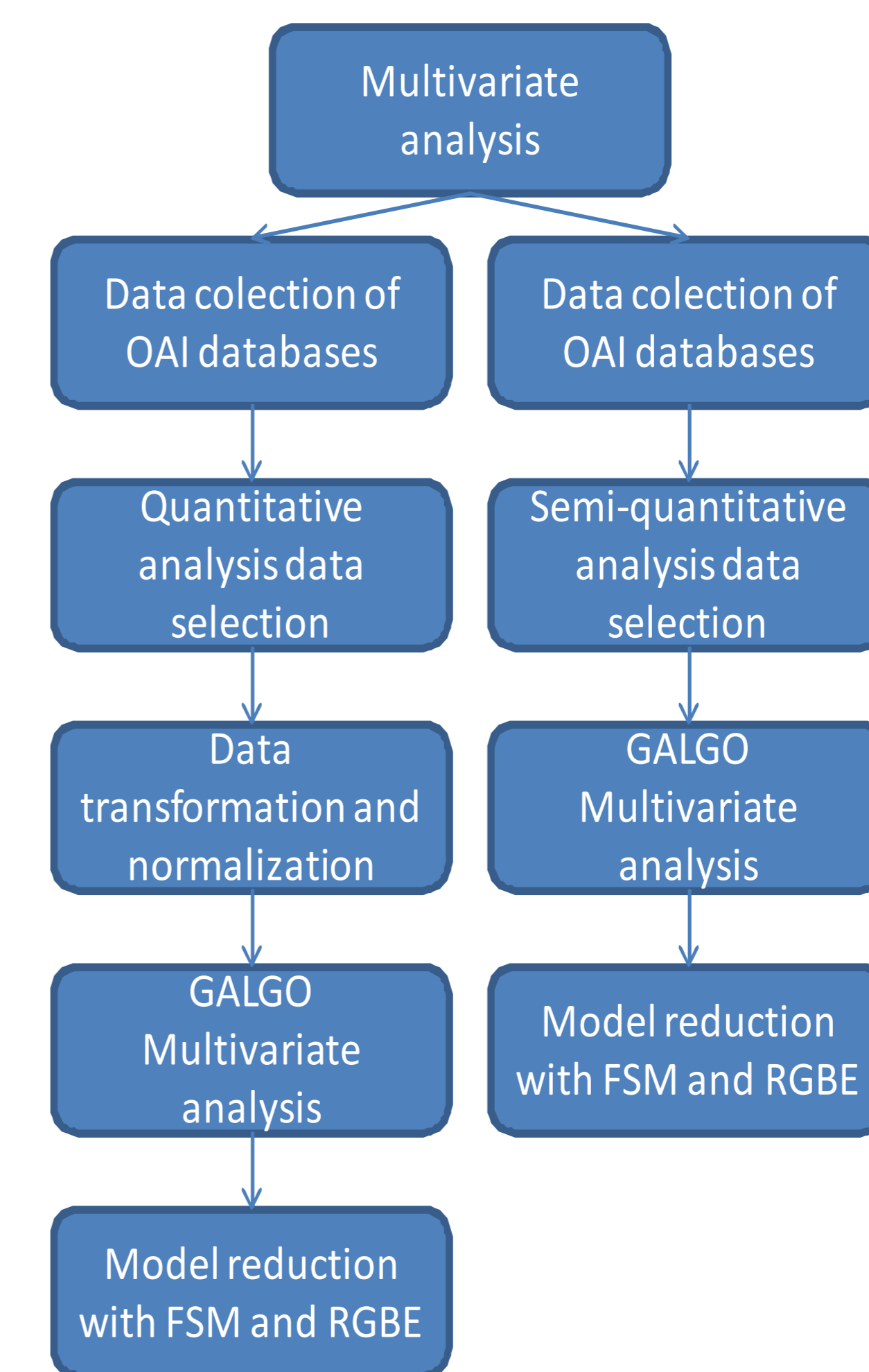
Figure 1. Analysis flowchart.

Table 2. Results

	Model	Feature		Odd	P-value	CI 95%	
Quantitative	T 0	JSW200	medial JSW at x=0.200 [mm]	6.19	0.05	1.08	53.23
		JSW225	medial JSW at x=0.225 [mm]	0.04	0.01	0.00	0.37
		JSW275	medial JSW at x=0.275 [mm]	12.03	>0.05	3.23	63.61
	T-1	JSW300	medial JSW at x=0.300 [mm]	1.76	0.07	0.98	3.35
		LJSW875	lateral JSW at x=0.850 [mm]	2.03	0.03	1.06	4.03
	T-2	JSW175	medial JSW at x=0.175 [mm]	0.35	0.10	0.10	1.19
		JSW150	medial JSW at x=0.150 [mm]	2.17	0.21	0.64	7.59
		JSW250	medial JSW at x=0.250 [mm]	0.23	0.11	0.03	1.23
		JSW275	medial JSW at x=0.275 [mm]	12.67	>0.05	2.64	84.30
Semi-quantitative	T 0	XRSCTM	sclerosis (OARSI) tibia med. comp.	0.20	0.07	0.02	0.96
		XRJSM	joint space narrowing (OARSI) med. comp.	0.66	0.28	0.30	1.40
		XRSCFM	sclerosis (OARSI) femur med. comp.	6.82	0.05	1.16	64.73
		XROSFM	osteophytes (OARSI) femur med. comp.	2.37	>0.05	1.34	4.61
	T-1	XROSFM	osteophytes (OARSI) femur med. comp.	2.73	>0.05	1.52	5.37
		XRSCFM	chondrocalcinosis (Grades 0-1) med. comp.	7.87	0.03	1.43	64.66
		XRJSM	joint space narrowing (OARSI) med. comp.	0.58	0.18	0.30	1.28
		XRSCTM	sclerosis (OARSI) tibia med. comp.	0.17	0.18	0.02	0.80
	T-2	XROSFM	osteophytes (OARSI) femur med. comp.	2.31	0.01	1.32	4.45
		XRKL	Kellgren and Lawrence (grades 0-4)	0.77	0.24	0.49	1.19

Table 1. Demographic Information

	Quantitative analysis subjects			Semi-quantitative analysis subjects		
	Cases	Controls	All	Cases	Controls	All
Subjects (Females)	65 (38)	98 (55)	163 (93)	63 (35)	60 (26)	123 (61)
Average height (σ) [m]	1.69 (.09)	1.68 (.1)	1.68 (.09)	1.66 (.23)	1.69 (.1)	1.67 (.18)
Average BMI (σ)	27.05 (4.3)	26.27 (4)	26.58 (4.1)	27.27 (4.4)	28.48 (4.1)	27.86 (4.3)
Average age (σ)	62.69 (9.6)	61.80 (10.1)	62.15 (9.9)	65.02 (9.6)	66.72 (8.7)	65.85 (9.2)
Age range	46 - 78	45 - 79	45 - 79	46 - 78	47 - 79	46 - 79