Propensity Score Analysis

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Contents

1 Patient population

- The total sample size in clean dataset is 469.
- Exclude 79 patients that didn't return their baseline questionnaires (total sample size=390).
- Exclude 4 patients without degree of certainty information (total sample size=386).
- Exclude 228 baseline-only patients (total sample size=158).
- Among 158 patients,138 of them are RCT+ (DOC+/MRI+ or DOC+/MRI missing). 5 patients are RCT- (DOC-). 15 patients are RCT missing (DOC+/MRI-).
- Among 138 RCT+ patients, 77 of them are non-operative (group2:non-operative and group6: delayed surgery without surgery date). 50 of them are operative group.
- 7 patients missing baseline SPADI score were excluded in non-operative predictor manuscript and PT variability manuscript. These 7 patients were included in current analysis. The sample size is 127.

2 Linear Mixed Effect Model with Weighted Propensity Score

2.1 Multiple Imputation for Baseline Values

- Missingness in our dataset is Missing At Random (MAR).
- Multiple Imputation (MI) was implemented using the "aregImpute" function in *Hmisc* R package for predictor imputation.
- MI imputes missing variables using the Predictive Mean Matching (PMM) method with weighted probability sampling of available data. All 24 predictors, including baseline SPADI, were included in MI procedure. SPADI at follow-up and treatment information were not included in MI.
- MI was repeated for 20 times to account for potential variability introduced by imputation. All imputed "complete" datasets were saved.

2.2 Model probability of treatment (propensity score)

2.2.1 Calculation of Propensity Score

- The propensity score is each patient's predicted probability of being assigned to surgical group, given the estimates from the logit model. Covariates that are related to both the treatment assignments and potential outcomes are included. (all 24 covariates)

$$\begin{aligned} logit(e_i) = \beta_0 + \beta_1 * age_i + \beta_2 * BicepsTendonitis_i + \beta_3 * Boileau_i + \beta_4 * DailyShoulderUseAtWork_i \\ +\beta_5 * DoYouDrinkAlcohol_i + \beta_6 * Education_i + \beta_7 * ExternalRotationRatio_i + \beta_8 * FABQ_i \\ +\beta_9 * FattyInfiltration_i + \beta_{10} * Gender_i + \beta_{11} * Infraspinatus_i + \beta_{12} * DominantAffected_i \\ +\beta_{13} * IsolatedAbductionRatio_i + \beta_{14} * MaritalStatus_i + \beta_{15} * MHI_i + \beta_{16} * Comorbidities_i \\ +\beta_{17} * NumOfTorn_i + \beta_{18} * SmokingStatus_i + \beta_{19} * Trauma_i + \beta_{20} * SymptomDuration_i \\ +\beta_{21} * BaselineSPADI_i + \beta_{22} * CrossArea_i + \beta_{23} * FullTear_i + \beta_{24} * Expectation_i \end{aligned}$$

- Final propensity score is the average predicted value from all imputation datasets.

2.2.2 Calculation of Matching Weights

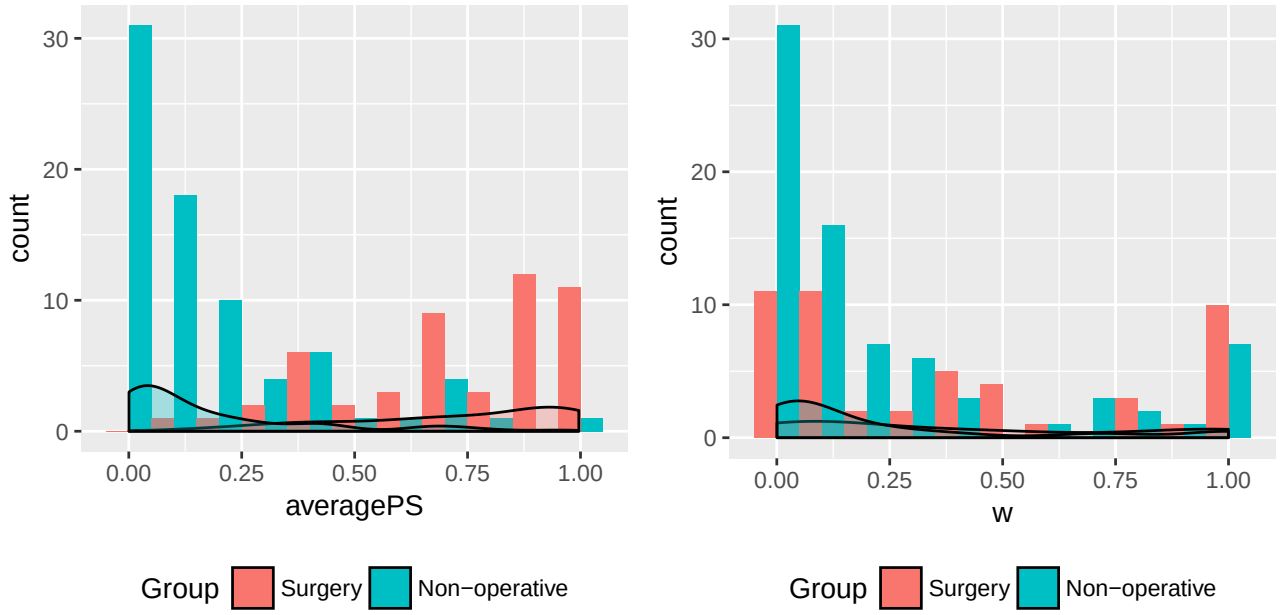
- Matched weights for treatment group:

$$min\{e_i, 1 - e_i\}/e_i$$

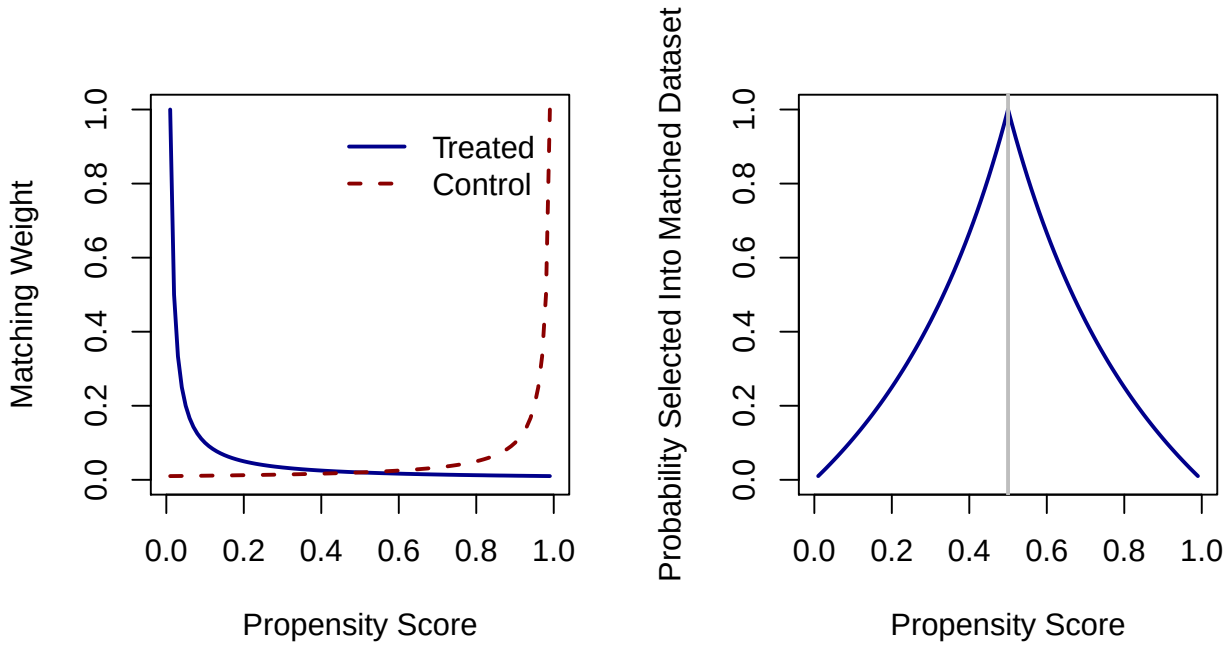
- Matched weights for control group:

$$min\{e_i, 1 - e_i\}/(1 - e_i)$$

2.2.3 Plots of Estimated Propensity Score and Matching Weights by Treatment



2.2.4 Weighting Scheme



2.3 Summary Table 1

		before weighting			after weighting		
		Surgery	Non-operative	SMD	Surgery	Non-operative	SMD
Age (mean(sd))		59.89 (8.65)	62.24 (8.10)	0.534	62.57 (6.66)	57.45 (6.70)	0.038
Biceps tendonitis/tenosynovitis (%)	1	35.0 (70.0)	54.0 (70.1)	0.003	14.5 (72.1)	13.9 (74.7)	0.060
	2	15.0 (30.0)	23.0 (29.9)		5.6 (27.9)	4.7 (25.3)	
Boileau (%)	1	29.0 (60.4)	49.0 (79.0)	0.414	11.3 (60.5)	9.5 (58.9)	0.032
	2	19.0 (39.6)	13.0 (21.0)		7.4 (39.5)	6.6 (41.1)	
Daily shoulder use at work (%)	1	37.0 (75.5)	63.0 (81.8)	0.154	15.8 (79.9)	14.8 (79.6)	0.008
	2	12.0 (24.5)	14.0 (18.2)		4.0 (20.1)	3.8 (20.4)	
Do you drink alcohol? (%)	1	18.0 (37.5)	43.0 (56.6)	0.389	9.6 (50.8)	9.5 (51.6)	0.015
	2	30.0 (62.5)	33.0 (43.4)		9.3 (49.2)	8.9 (48.4)	
Education (%)	1	16.0 (33.3)	26.0 (34.2)	0.019	6.0 (31.6)	6.7 (36.4)	0.101
	2	32.0 (66.7)	50.0 (65.8)		12.9 (68.4)	11.7 (63.6)	
external rotation ratio (mean(sd))		0.52 (0.30)	0.83 (0.42)	0.768	0.65 (0.33)	0.70 (0.30)	0.105
FABQ (mean(sd))		18.89 (4.30)	16.36 (6.06)	0.495	17.75 (4.94)	17.05 (4.91)	0.050
Fatty infiltration (%)	1	23.0 (54.8)	41.0 (71.9)	0.362	8.4 (51.6)	8.9 (58.9)	0.147
	2	19.0 (45.2)	16.0 (28.1)		7.8 (48.4)	6.2 (41.1)	
Gender (%)	1	19.0 (38.0)	39.0 (50.6)	0.257	9.1 (45.6)	8.3 (44.7)	0.017
	2	31.0 (62.0)	38.0 (49.4)		10.9 (54.4)	10.3 (55.3)	
Infraspinatus (%)	1	29.0 (60.4)	45.0 (72.6)	0.260	10.0 (53.7)	9.3 (57.5)	0.077
	2	19.0 (39.6)	17.0 (27.4)		8.6 (46.3)	6.9 (42.5)	
Is dominant shoulder affected? (%)	1	11.0 (22.9)	18.0 (24.7)	0.041	5.7 (29.0)	5.4 (30.1)	0.023
	2	37.0 (77.1)	55.0 (75.3)		14.0 (71.0)	12.5 (69.9)	
Isolated abduction ratio (mean(sd))		0.86 (0.21)	0.89 (0.19)	0.110	0.87 (0.20)	0.88 (0.21)	0.041
Marital status (%)	1	11.0 (22.0)	21.0 (28.0)	0.139	5.5 (27.5)	4.8 (26.1)	0.032
	2	39.0 (78.0)	54.0 (72.0)		14.5 (72.5)	13.6 (73.9)	
MHI-5 (mean(sd))		80.24 (18.82)	81.79 (13.80)	0.013	80.59 (17.86)	86.97 (9.56)	0.035
Number of Comorbidities (%)	1	29.0 (58.0)	34.0 (44.2)	0.280	9.8 (48.9)	9.6 (51.3)	0.048
	2	21.0 (42.0)	43.0 (55.8)		10.3 (51.1)	9.1 (48.7)	
Number of torn (%)	1	29.0 (60.4)	44.0 (71.0)	0.224	9.9 (53.0)	9.2 (57.1)	0.083
	2	19.0 (39.6)	18.0 (29.0)		8.8 (47.0)	6.9 (42.9)	
Smoking Status (%)	1	24.0 (50.0)	37.0 (48.7)	0.026	8.9 (47.2)	8.7 (47.3)	0.002
	2	24.0 (50.0)	39.0 (51.3)		10.0 (52.8)	9.7 (52.7)	
Trauma (%)	1	23.0 (46.0)	42.0 (59.2)	0.266	9.6 (47.9)	7.4 (45.2)	0.055
	2	27.0 (54.0)	29.0 (40.8)		10.5 (52.1)	9.0 (54.8)	
Symptom Duration (mean(sd))		24.27 (43.52)	23.54 (42.98)	0.048	26.19 (50.59)	33.74 (61.19)	0.035
SPADI at baseline (mean(sd))		57.49 (20.10)	42.97 (20.99)	0.493	51.62 (20.20)	39.81 (18.23)	0.025
Cross-sectional Area (mean(sd))		14.73 (19.29)	8.38 (16.44)	0.376	14.79 (22.55)	21.73 (24.34)	0.039
Full tear of any tendons? (%)	1	5.0 (10.4)	28.0 (45.2)	0.841	2.8 (15.2)	2.5 (15.4)	0.005
	2	43.0 (89.6)	34.0 (54.8)		15.8 (84.8)	13.7 (84.6)	
Patient Expectation (%)	1	47.0 (94.0)	49.0 (65.3)	0.762	17.5 (87.4)	15.8 (85.2)	0.067
	2	3.0 (6.0)	26.0 (34.7)		2.5 (12.6)	2.8 (14.8)	

2.4 Summary Table 2

	Surgery $N = 50$	Non-operative $N = 77$	Combined $N = 127$
Age	51.6 59.1 64.6 (59.3 ± 8.9)	59.3 64.6 68.6 (63.8 ± 8.3)	54.8 63.0 67.9 (62.0 ± 8.8)
Biceps tendonitis			
1	70% (35)	70% (54)	70% (89)
2	30% (15)	30% (23)	30% (38)
Boileau			
1	58% (29)	64% (49)	61% (78)
2	38% (19)	17% (13)	25% (32)
NA	4% (2)	19% (15)	13% (17)
Daily shoulder use at work			
1	74% (37)	82% (63)	79% (100)
2	24% (12)	18% (14)	20% (26)
NA	2% (1)	0% (0)	1% (1)
Do you drink alcohol?			
1	36% (18)	56% (43)	48% (61)
2	60% (30)	43% (33)	50% (63)
NA	4% (2)	1% (1)	2% (3)
Education			
1	32% (16)	34% (26)	33% (42)
2	64% (32)	65% (50)	65% (82)
NA	4% (2)	1% (1)	2% (3)
External Rotation Ratio	0.31 0.51 0.71 (0.54 ±0.29)	0.59 0.76 0.98 (0.83 ±0.45)	0.49 0.68 0.91 (0.72 ±0.42)
FABQ	17.0 19.0 22.8 (19.0 ± 4.3)	12.0 18.0 21.0 (16.4 ± 6.1)	15.0 18.5 21.0 (17.5 ± 5.6)
Fatty infiltration			
1	46% (23)	53% (41)	50% (64)
2	38% (19)	21% (16)	28% (35)
NA	16% (8)	26% (20)	22% (28)
Gender			
1	38% (19)	51% (39)	46% (58)
2	62% (31)	49% (38)	54% (69)
Infraspinatus			
1	58% (29)	58% (45)	58% (74)
2	38% (19)	22% (17)	28% (36)
NA	4% (2)	19% (15)	13% (17)
Is dominant shoulder affected?			
1	22% (11)	23% (18)	23% (29)
2	74% (37)	71% (55)	72% (92)
NA	4% (2)	5% (4)	5% (6)
Isolated Abduction Ratio	0.76 0.94 1.00 (0.87 ±0.20)	0.80 0.94 1.00 (0.89 ±0.18)	0.79 0.94 1.00 (0.88 ±0.19)
Marital status			
1	22% (11)	27% (21)	25% (32)
2	78% (39)	70% (54)	73% (93)
NA	0% (0)	3% (2)	2% (2)
MHI-5	76 85 90 (80 ±17)	75 85 90 (80 ±15)	75 85 90 (80 ±16)

$_a\ b\ _c$ represent the lower quartile a, the median b, and the upper quartile c for continuous variables. $x \pm s$ represents $\bar{X} \pm 1$ SD. Numbers after percents are frequencies.

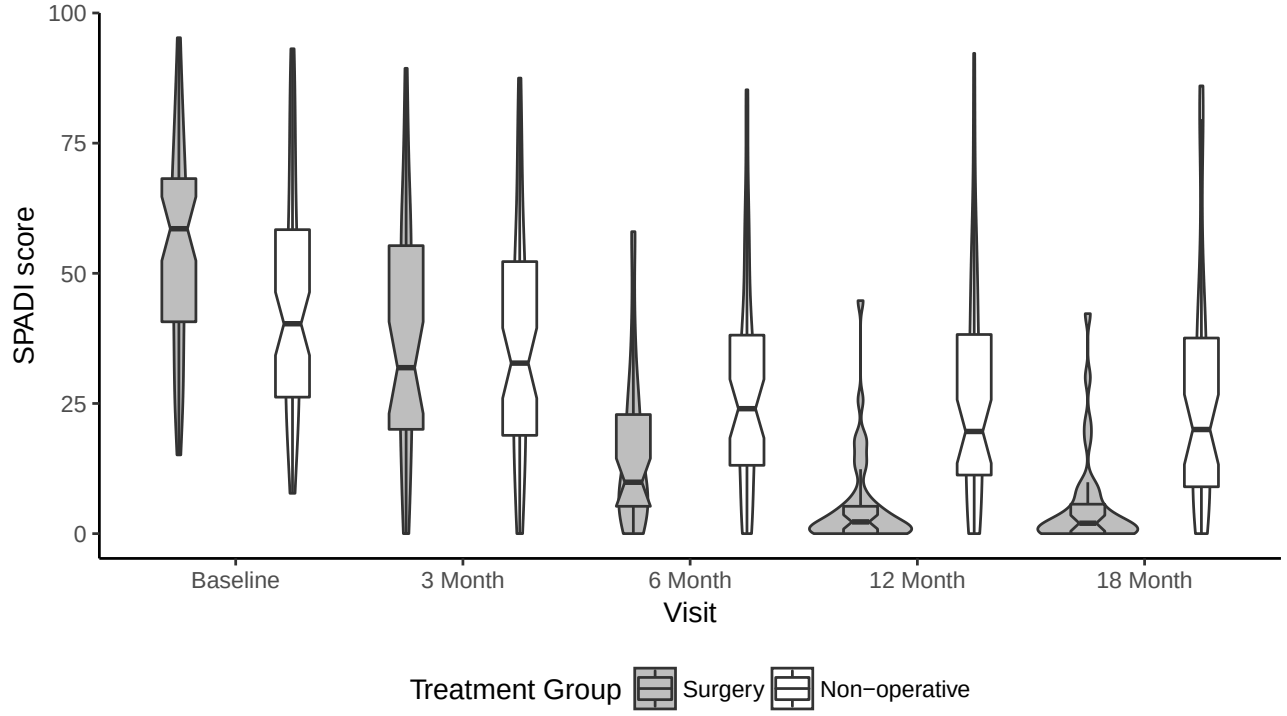
	Surgery $N = 50$	Non-operative $N = 77$	Combined $N = 127$
Number of comorbidities			
1	58% (29)	44% (34)	50% (63)
2	42% (21)	56% (43)	50% (64)
Number of torn			
1	58% (29)	57% (44)	57% (73)
2	38% (19)	23% (18)	29% (37)
NA	4% (2)	19% (15)	13% (17)
Smoking status			
1	48% (24)	48% (37)	48% (61)
2	48% (24)	51% (39)	50% (63)
NA	4% (2)	1% (1)	2% (3)
Trauma			
1	46% (23)	55% (42)	51% (65)
2	54% (27)	38% (29)	44% (56)
NA	0% (0)	8% (6)	5% (6)
When did problem start?	2.2 6.0 18.0 (22.6 ±40.6)	4.0 6.0 18.0 (24.9 ±54.3)	3.2 6.0 18.0 (23.9 ±49.0)
SPADI at Baseline	41 59 68 (55 ±21)	26 40 58 (44 ±23)	29 46 65 (49 ±23)
Cross-sectional area	1.82 3.23 20.86 (14.48 ±19.35)	0.00 0.72 4.40 (7.93 ±15.34)	0.00 2.21 12.03 (10.88 ±17.48)
Full tear of any tendons?			
1	10% (5)	36% (28)	26% (33)
2	86% (43)	44% (34)	61% (77)
NA	4% (2)	19% (15)	13% (17)
Patient expectation			
1	94% (47)	64% (49)	76% (96)
2	6% (3)	34% (26)	23% (29)
NA	0% (0)	3% (2)	2% (2)

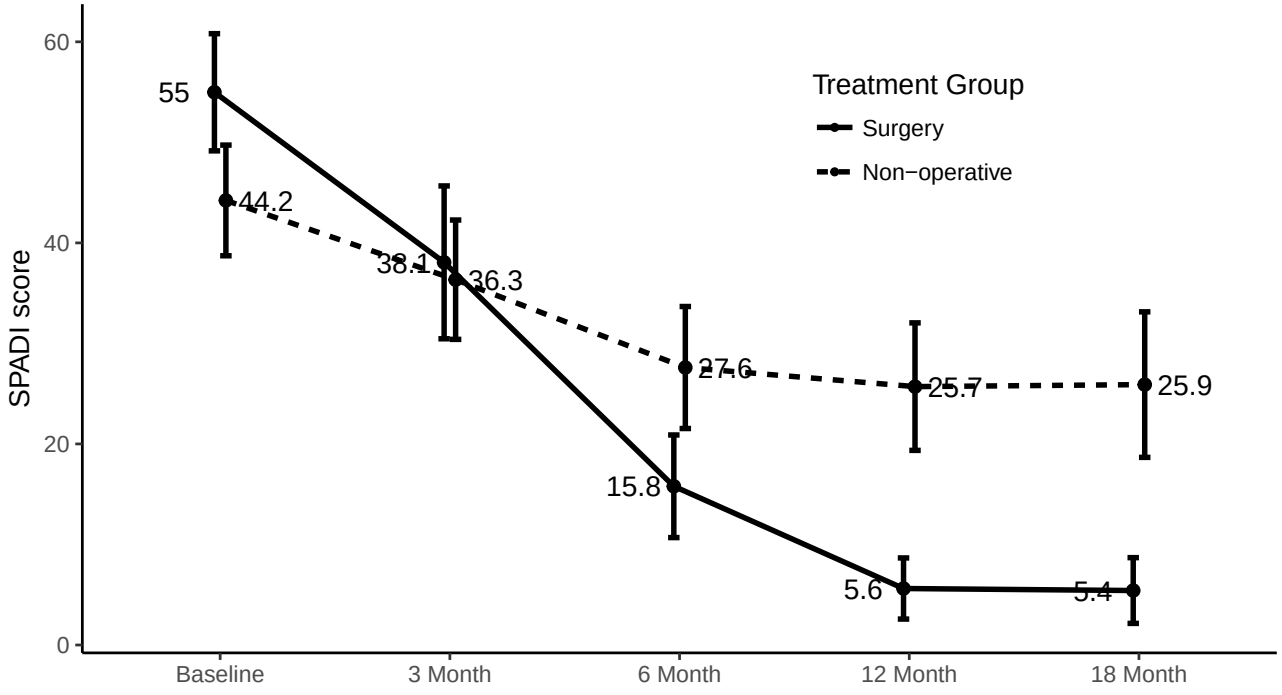
$_a$ b $_c$ represent the lower quartile a, the median b, and the upper quartile c for continuous variables. $x \pm s$ represents $\bar{X} \pm 1$ SD. Numbers after percents are frequencies.

2.5 Summary of missingness for 8 continuous variables at 3 month visit

df	of missing	Percent of missing (%)
baseline SPADI	7	5.51
Age	0	0.00
External rotation ratio	8	6.30
FABQ	5	3.94
Isolated abduction ratio	10	7.87
MHI-5	2	1.57
When did problem start	5	3.94
cross-sectional area	27	21.26

2.6 SPADI Change Over Time by Treatment Groups (with 95% confidence interval)





tab	Surgery	Non-operative	Difference	Lower CI	Upper CI	P value
Baseline	54.983	44.223	10.759	3.375	20.500	0.007
3 Month	38.062	36.338	1.725	−8.500	11.125	0.627
6 Month	15.787	27.601	−11.814	−18.125	−3.250	0.004
12 Month	5.618	25.702	−20.083	−22.875	−10.875	0.000
18 Month	5.419	25.902	−20.483	−22.500	−8.375	0.000

2.7 Identify the Best Model of SPADI Over Time

- Fit1: spadi ~visit + visit^2, numeric visit, compound symmetry correlation structure. AIC for fit1 is 3485.02.
- Fit2: spadi ~visit + visit^2, numeric visit, AR(1) Correlation Structure. AIC for fit2 is 3525.95
- Fit3: spadi ~visit, visit as factor variable, compound symmetry correlation structure. AIC for fit3 is 3482.4
- Fit4: spadi ~visit, visit as factor variable, AR(1) Correlation Structure. AIC for fit4 is 3522.04
- AIC for models with numeric and categorical visit is very similar. Compound symmetry correlation structure yields smaller AIC than AR(1) correlation struction.

2.8 Model Fit with Treatment and Weight

2.8.1 No interaction model

```
##                              lower  est. upper p.value
## (Intercept)                  16.72  25.1  33.4   0.000
## visit_new6 Month             -9.45  -6.7  -4.0   0.000
## visit_new12 Month            -9.29  -6.6  -4.0   0.000
## visit_new18 Month           -13.00 -10.1  -7.2   0.000
## operative_newNon-operative    0.25  10.2  20.2   0.046
```

2.8.2 Model with interaction

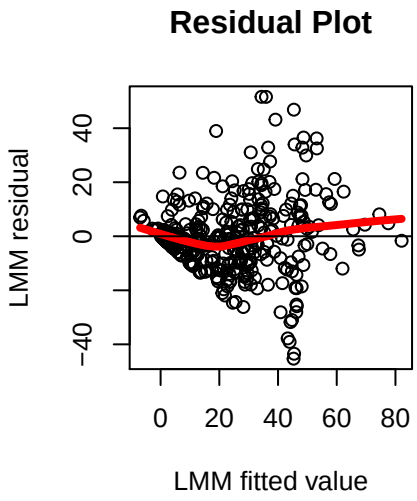
```
##                                              lower est. upper p.value
## (Intercept)                                     38   47  56.4   0.000
## visit_new6 Month                               -43  -34 -25.6   0.000
## visit_new12 Month                              -52  -43 -34.6   0.000
## visit_new18 Month                              -52  -42 -32.8   0.000
## operative_newNon-operative                     -24  -14  -2.7   0.016
## visit_new6 Month:operative_newNon-operative     21   30  38.8   0.000
## visit_new12 Month:operative_newNon-operative    31   40  48.5   0.000
## visit_new18 Month:operative_newNon-operative    25   35  44.6   0.000
```

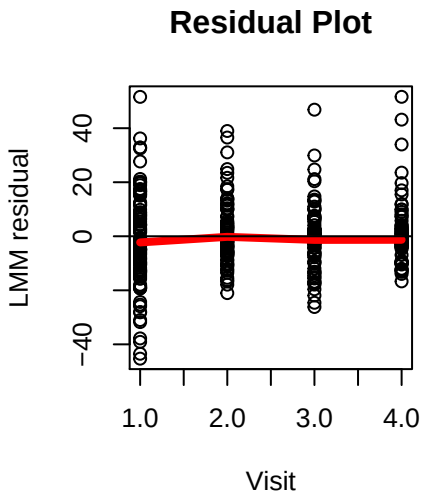
2.8.3 Model comparison

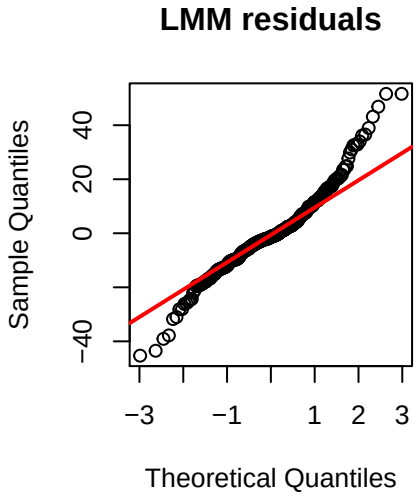
```
##           Model df  AIC  BIC logLik   Test L.Ratio p-value
## finalfit1     1  8 3520 3551  -1752
## finalfit2     2 11 3448 3490  -1713 1 vs 2      78  <.0001
```

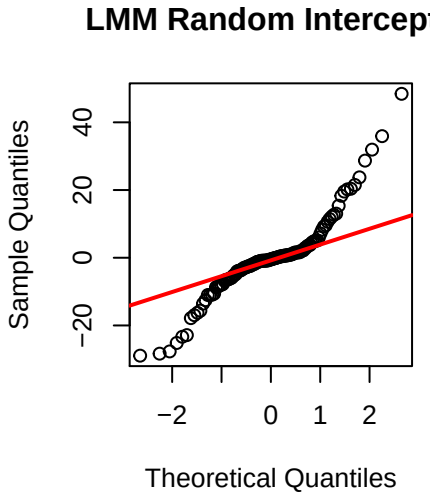
- Model with visit and treatment interaction is the final model.

2.8.4 Residual Plot of Final Model



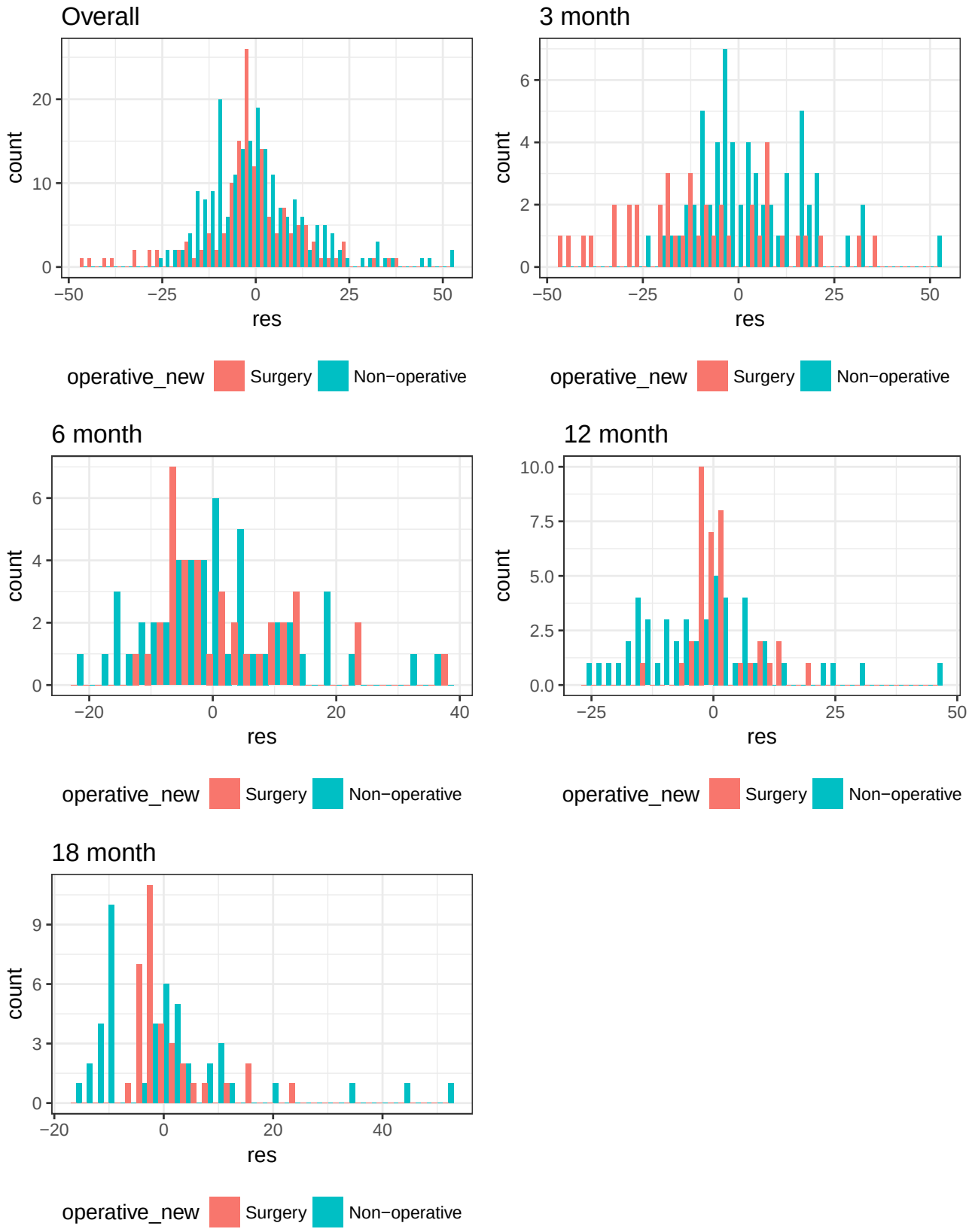




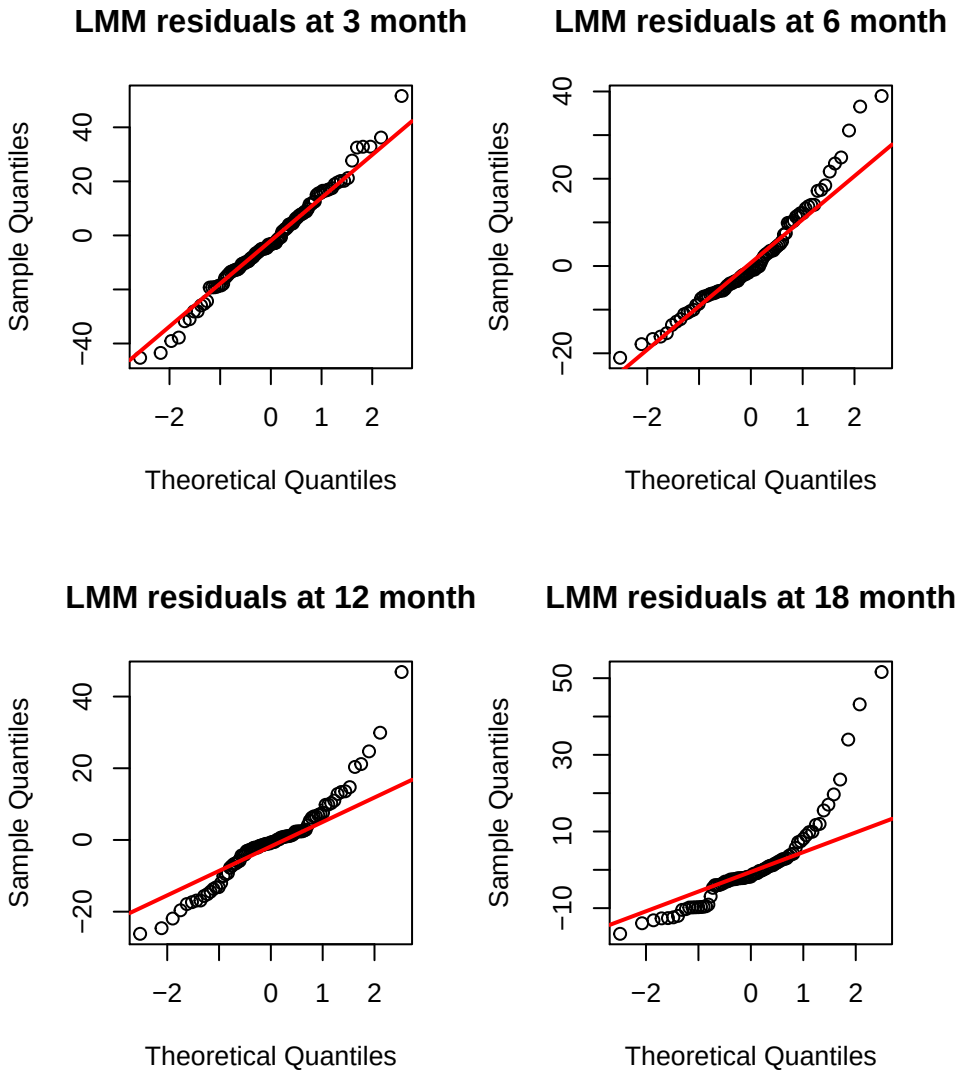


- Anderson-Darling normality test for LMM residuals is 9.76×10^{-11}.
- Anderson-Darling normality test for LMM random intercepts is 4.48×10^{-12}.

2.8.5 Residual Plot of Final Model - histogram

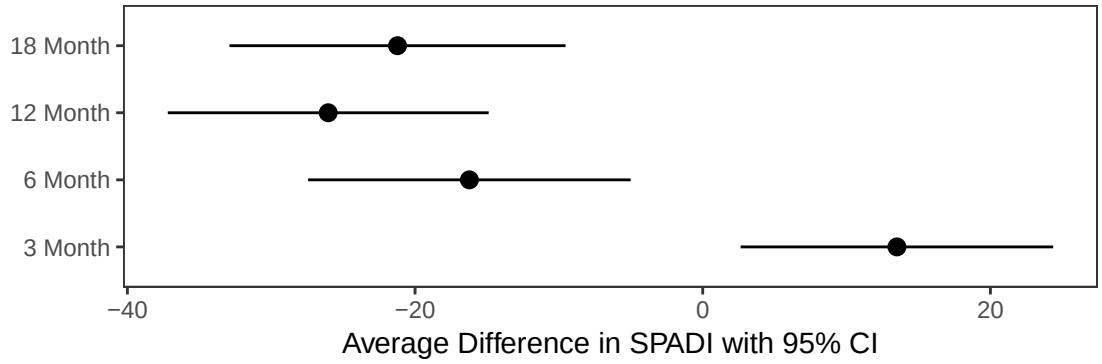


2.8.6 LMM Residual Plot of Final Model by Visit



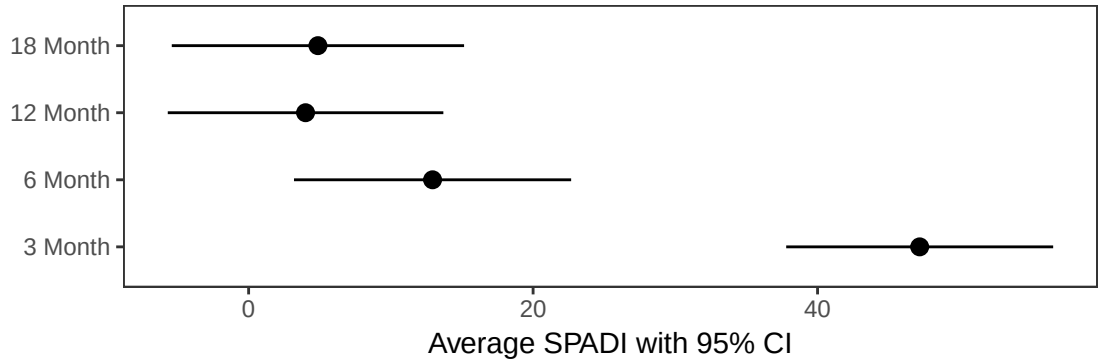
- Anderson-Darling normality test for LMM residuals at 3 month is 0.5583.
- Anderson-Darling normality test for LMM residuals at 6 month is 0.0016.
- Anderson-Darling normality test for LMM residuals at 12 month is 7.0783×10^{-4}.
- Anderson-Darling normality test for LMM residuals at 18 month is 3.8864×10^{-9}.

2.8.7 LS Means for Difference Between Operative and Non-operative Groups in Final Model



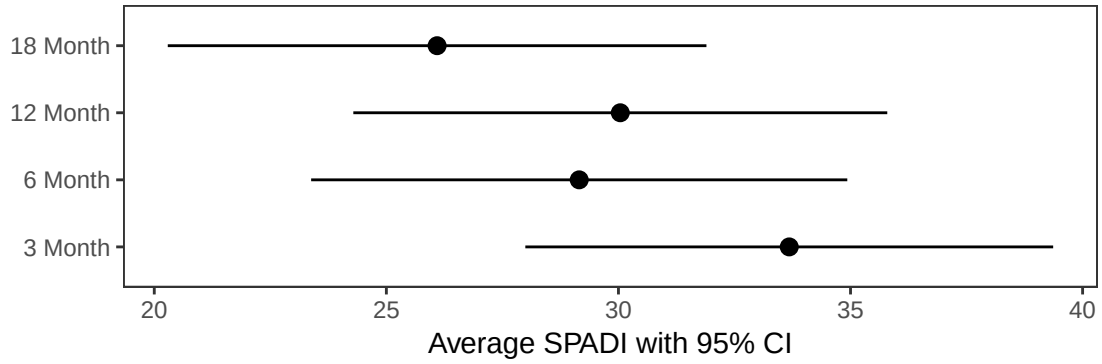
contrast	visit$_new$	estimate	SE	df	t.ratio	p.value	upper	lower
Surgery - Non-operative	3 Month	14	5.5	122	2.4	$1.6e-02$	24.4	2.6
Surgery - Non-operative	6 Month	−16	5.7	122	−2.8	$5.4e-03$	−5.0	−27.4
Surgery - Non-operative	12 Month	−26	5.7	122	−4.6	$1.2e-05$	−14.9	−37.2
Surgery - Non-operative	18 Month	−21	6.0	122	−3.6	$5.3e-04$	−9.5	−32.9

2.8.8 LS Means for Operative Group in Final Model



operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Surgery	3 Month	47.2	4.7	123	37.8	57
Surgery	6 Month	12.9	4.9	123	3.2	23
Surgery	12 Month	4.0	4.9	123	−5.7	14
Surgery	18 Month	4.9	5.2	123	−5.4	15

2.8.9 LS Means for Non-operative Group in Final Model



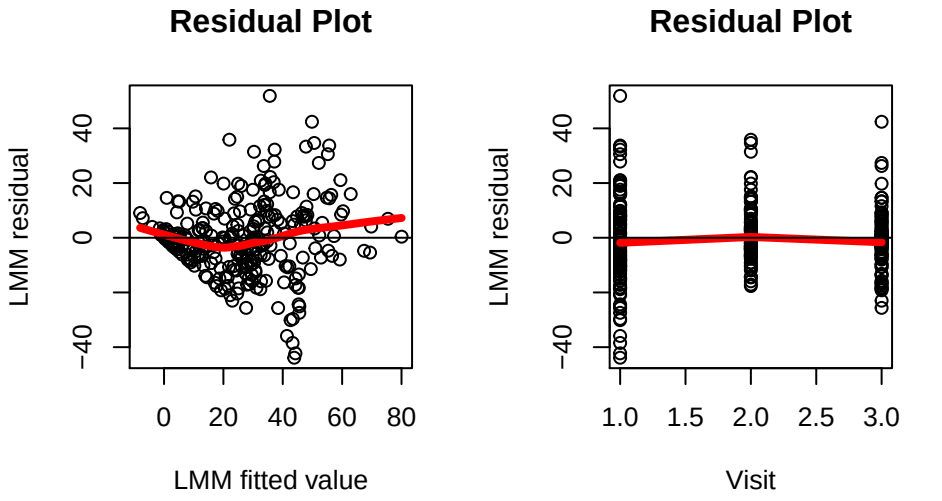
operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Non-operative	3 Month	34	2.9	122	28	39
Non-operative	6 Month	29	2.9	122	23	35
Non-operative	12 Month	30	2.9	122	24	36
Non-operative	18 Month	26	2.9	122	20	32

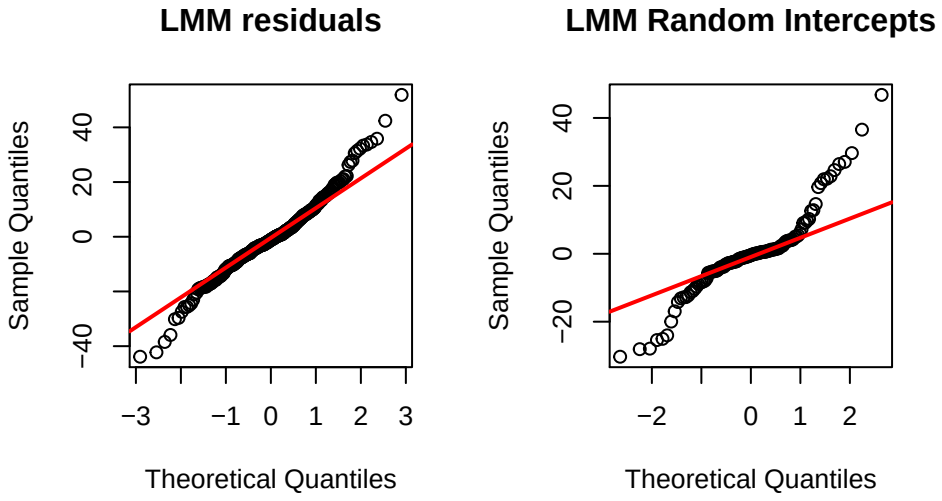
2.9 Model with interaction - 18 month data removed

2.9.1 Model Fitting

```
##                                                lower est. upper p.value
## (Intercept)                                       37   47  55.8   0.000
## visit_new6 Month                                 -43  -34 -24.0   0.000
## visit_new12 Month                                -51  -42 -34.0   0.000
## operative_newNon-operative                       -24  -13  -2.6   0.017
## visit_new6 Month:operative_newNon-operative       19   29  39.1   0.000
## visit_new12 Month:operative_newNon-operative      31   39  48.1   0.000
```

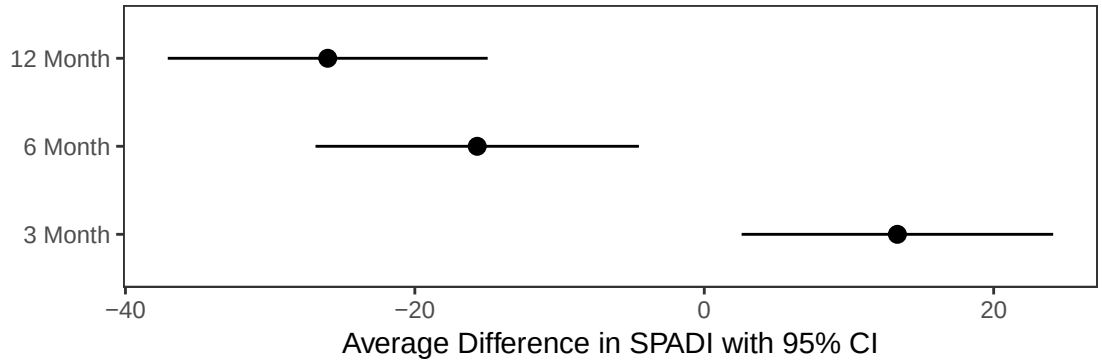
2.9.2 Residual Plot of Final Model





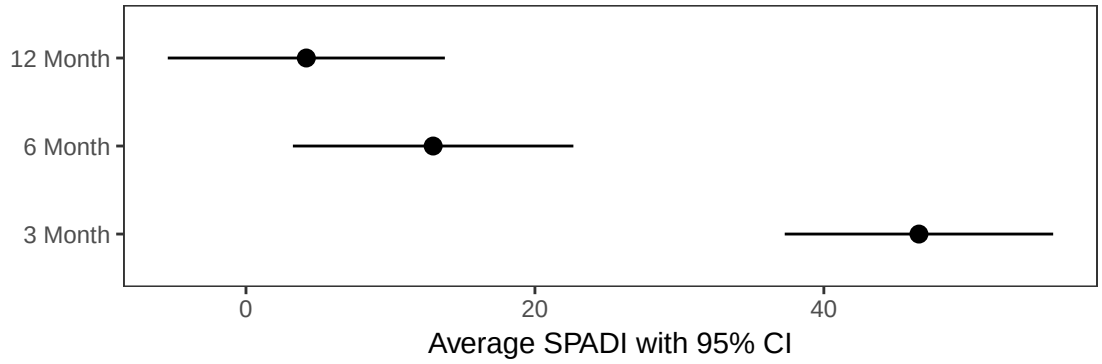
- Anderson-Darling normality test for LMM residuals is 8.2×10^{-5}.
- Anderson-Darling normality test for LMM random intercepts is 8.41×10^{-12}.

2.9.3 LS Means for Difference Between Operative and Non-operative Groups in Final Model



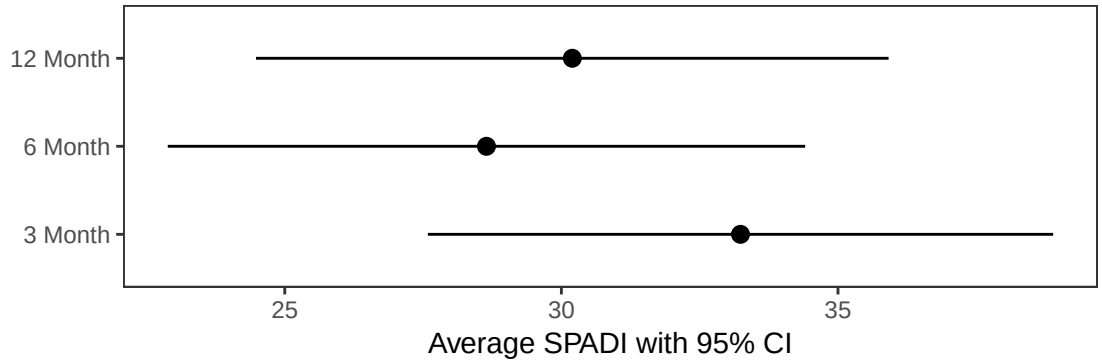
contrast	visit$_new$	estimate	SE	df	t.ratio	p.value	upper	lower
Surgery - Non-operative	3 Month	13	5.5	119	2.4	0.01661	24.1	2.6
Surgery - Non-operative	6 Month	−16	5.7	119	−2.8	0.00685	−4.5	−26.9
Surgery - Non-operative	12 Month	−26	5.6	119	−4.6	0.00001	−15.0	−37.1

2.9.4 LS Means for Operative Group in Final Model



operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Surgery	3 Month	46.6	4.7	120	37.3	56
Surgery	6 Month	13.0	4.9	120	3.2	23
Surgery	12 Month	4.2	4.8	120	−5.4	14

2.9.5 LS Means for Non-operative Group in Final Model



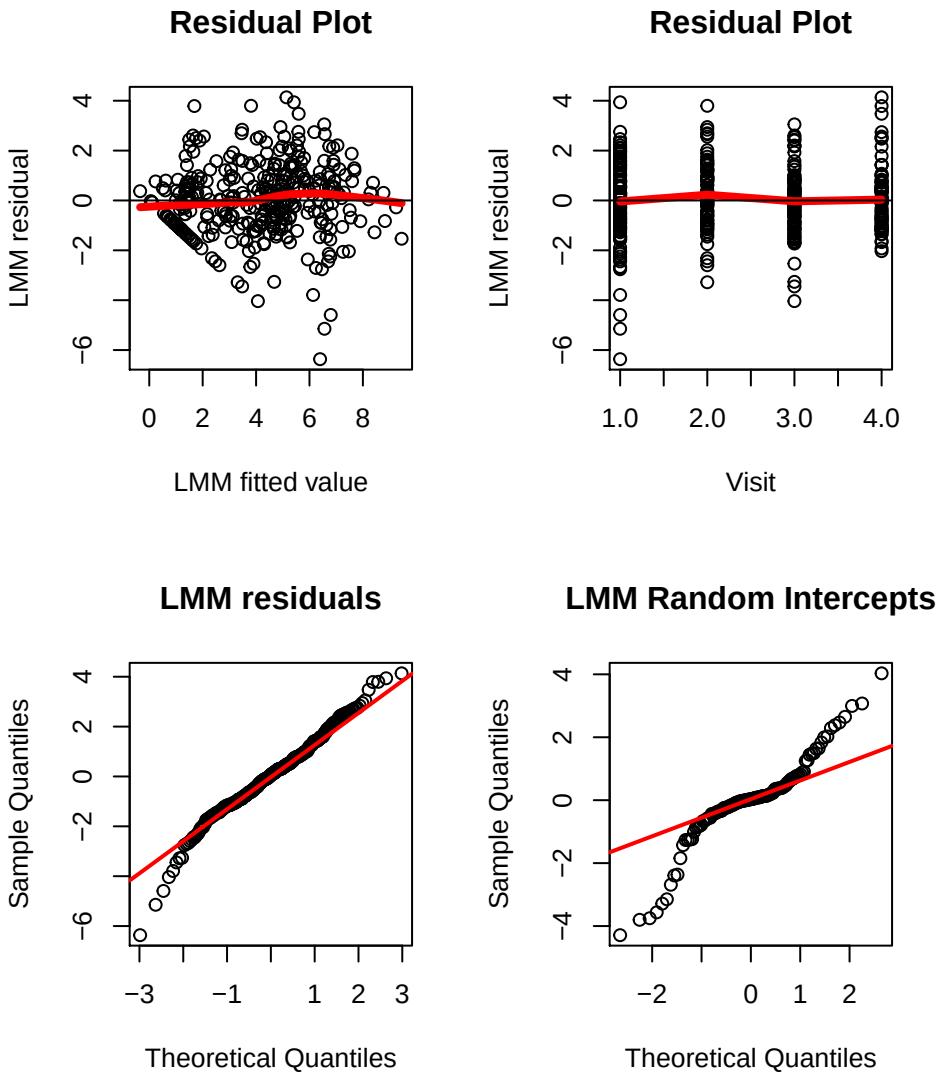
operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Non-operative	3 Month	33	2.9	119	28	39
Non-operative	6 Month	29	2.9	119	23	34
Non-operative	12 Month	30	2.9	119	24	36

2.10 Model with square-root transformed outcome

2.10.1 Model Fitting

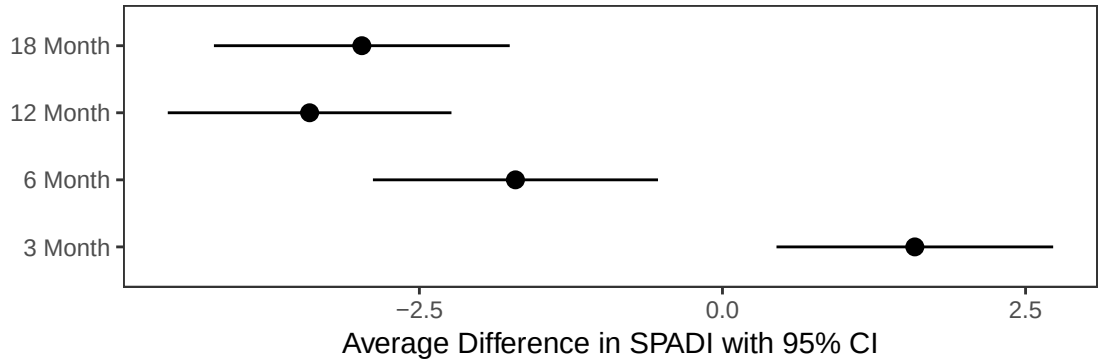
```
##                                                lower est. upper p.value
## (Intercept)                                      5.8  6.8  7.77   0.000
## visit_new6 Month                                -4.7 -3.8 -2.87   0.000
## visit_new12 Month                               -6.2 -5.3 -4.42   0.000
## visit_new18 Month                               -6.4 -5.4 -4.46   0.000
## operative_newNon-operative                      -2.7 -1.6 -0.45   0.007
## visit_new6 Month:operative_newNon-operative      2.4  3.3  4.23   0.000
## visit_new12 Month:operative_newNon-operative     4.1  5.0  5.90   0.000
## visit_new18 Month:operative_newNon-operative     3.6  4.6  5.56   0.000
```

2.10.2 Residual Plot of Final Model



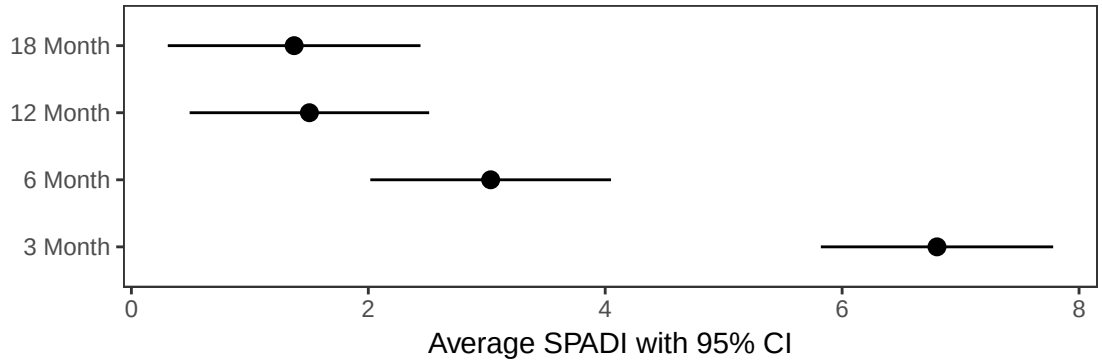
- Anderson-Darling normality test for LMM residuals is 0.01.
- Anderson-Darling normality test for LMM random intercepts is 5.14×10^{-12}.

2.10.3 LS Means for Difference Between Operative and Non-operative Groups in Final Model



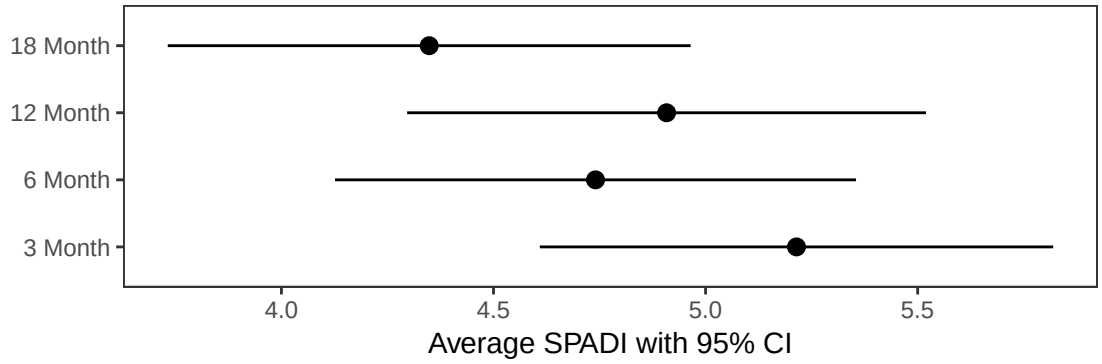
contrast	visit$_new$	estimate	SE	df	t.ratio	p.value	upper	lower
Surgery - Non-operative	3 Month	1.6	0.58	122	2.7	$7.4e-03$	2.73	0.45
Surgery - Non-operative	6 Month	−1.7	0.60	122	−2.8	$5.2e-03$	−0.53	−2.88
Surgery - Non-operative	12 Month	−3.4	0.60	122	−5.7	$8.3e-08$	−2.24	−4.58
Surgery - Non-operative	18 Month	−3.0	0.62	122	−4.8	$5.0e-06$	−1.75	−4.19

2.10.4 LS Means for Operative Group in Final Model



operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Surgery	3 Month	6.8	0.50	123	5.82	7.8
Surgery	6 Month	3.0	0.51	123	2.02	4.0
Surgery	12 Month	1.5	0.51	123	0.49	2.5
Surgery	18 Month	1.4	0.54	123	0.31	2.4

2.10.5 LS Means for Non-operative Group in Final Model



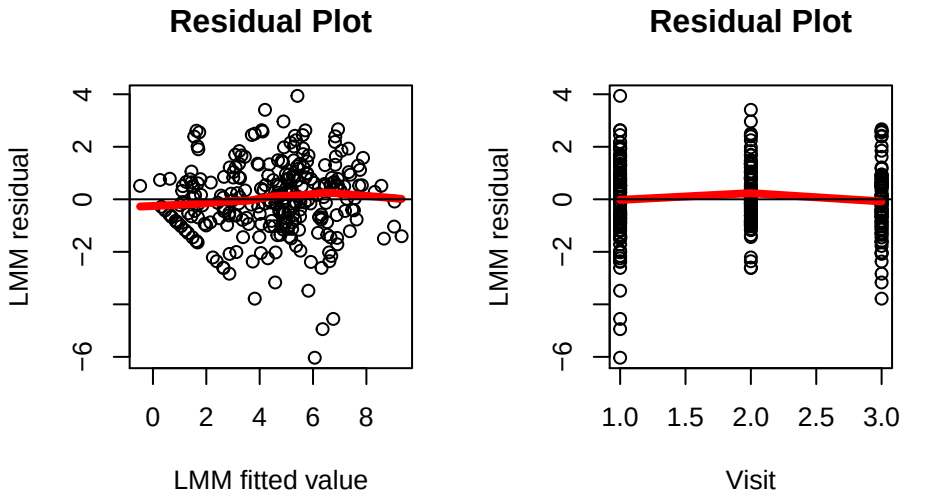
operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Non-operative	3 Month	5.2	0.31	122	4.6	5.8
Non-operative	6 Month	4.7	0.31	122	4.1	5.4
Non-operative	12 Month	4.9	0.31	122	4.3	5.5
Non-operative	18 Month	4.3	0.31	122	3.7	5.0

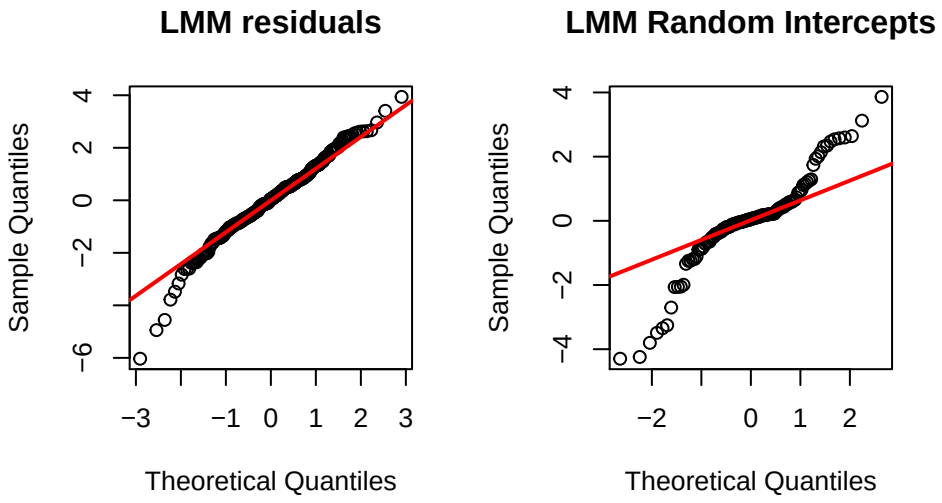
2.11 Model with square-root transformed outcome - 18 month data removed

2.11.1 Model Fitting

```
##                                                lower est. upper p.value
## (Intercept)                                      5.8  6.7  7.66   0.000
## visit_new6 Month                                -4.7 -3.7 -2.69   0.000
## visit_new12 Month                               -6.0 -5.2 -4.40   0.000
## operative_newNon-operative                      -2.6 -1.5 -0.43   0.008
## visit_new6 Month:operative_newNon-operative      2.2  3.2  4.21   0.000
## visit_new12 Month:operative_newNon-operative     4.1  4.9  5.79   0.000
```

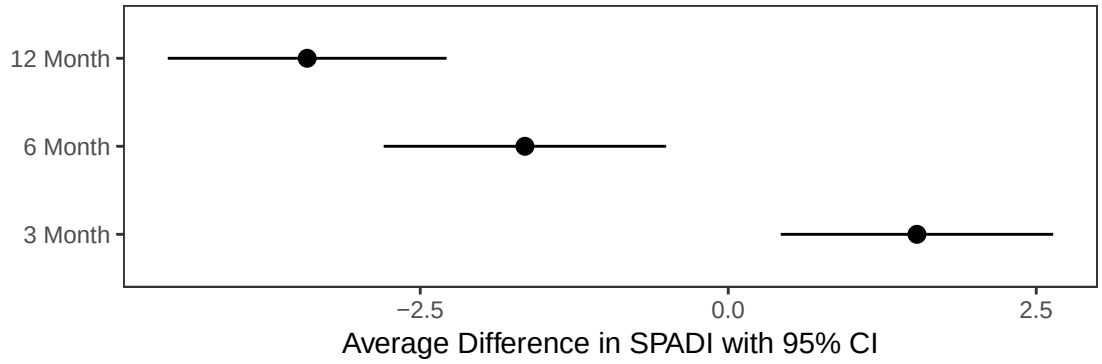
2.11.2 Residual Plot of Final Model





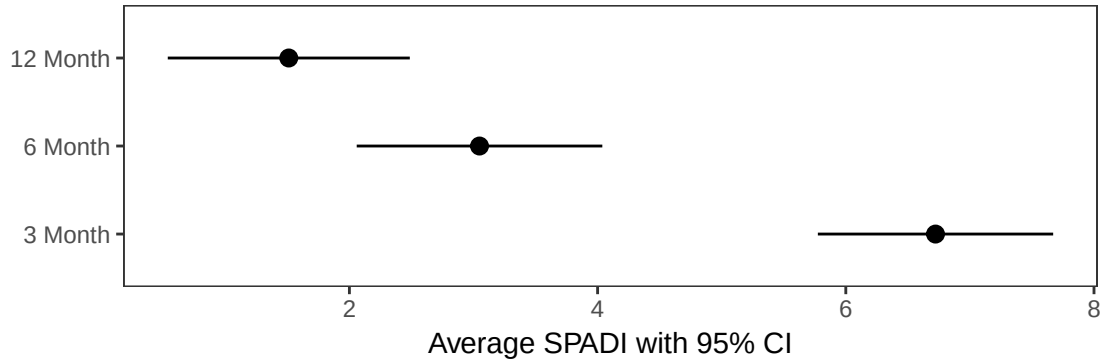
- Anderson-Darling normality test for LMM residuals is 0.03.
- Anderson-Darling normality test for LMM random intercepts is 2.37×10^{-11}.

2.11.3 LS Means for Difference Between Operative and Non-operative Groups in Final Model



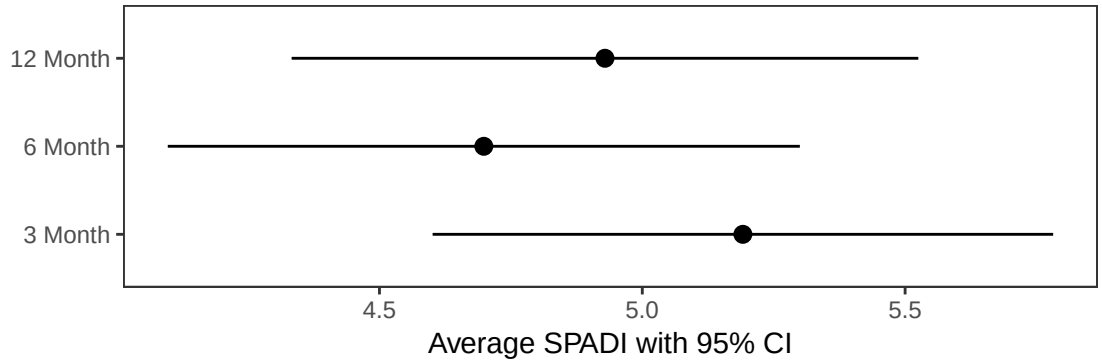
contrast	visit$_new$	estimate	SE	df	t.ratio	p.value	upper	lower
Surgery - Non-operative	3 Month	1.5	0.56	119	2.7	$7.6e-03$	2.6	0.43
Surgery - Non-operative	6 Month	−1.7	0.58	119	−2.8	$5.6e-03$	−0.5	−2.80
Surgery - Non-operative	12 Month	−3.4	0.58	119	−5.9	$3.2e-08$	−2.3	−4.55

2.11.4 LS Means for Operative Group in Final Model



operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Surgery	3 Month	6.7	0.48	120	5.77	7.7
Surgery	6 Month	3.0	0.50	120	2.06	4.0
Surgery	12 Month	1.5	0.49	120	0.54	2.5

2.11.5 LS Means for Non-operative Group in Final Model



operative$_new$	visit$_new$	lsmean	SE	df	lower.CL	upper.CL
Non-operative	3 Month	5.2	0.3	119	4.6	5.8
Non-operative	6 Month	4.7	0.3	119	4.1	5.3
Non-operative	12 Month	4.9	0.3	119	4.3	5.5

2.12 List of Patients in Final Model

baseline	3 month	6 month	12 month	18 month
1-1-008	1-1-008	1-1-008	1-1-008	1-1-008
1-1-017	1-1-017	1-1-017		
1-1-020			1-1-020	
1-1-033	1-1-033	1-1-033	1-1-033	1-1-033
1-1-037	1-1-037	1-1-037	1-1-037	1-1-037
1-1-038	1-1-038	1-1-038		1-1-038
1-1-040	1-1-040	1-1-040	1-1-040	1-1-040
1-1-044	1-1-044	1-1-044	1-1-044	1-1-044
1-1-047	1-1-047		1-1-047	
1-1-055	1-1-055	1-1-055	1-1-055	1-1-055
1-1-058	1-1-058		1-1-058	1-1-058
1-1-059	1-1-059			
1-1-062	1-1-062	1-1-062	1-1-062	1-1-062
1-1-063	1-1-063		1-1-063	1-1-063
1-1-064				
1-1-067	1-1-067	1-1-067		
1-1-071	1-1-071	1-1-071	1-1-071	1-1-071
1-1-076			1-1-076	1-1-076
1-1-081	1-1-081	1-1-081	1-1-081	1-1-081
1-1-096	1-1-096	1-1-096	1-1-096	1-1-096
1-1-099	1-1-099	1-1-099		
1-1-114	1-1-114	1-1-114	1-1-114	1-1-114
1-1-115	1-1-115		1-1-115	1-1-115
1-1-127			1-1-127	
1-1-140	1-1-140	1-1-140	1-1-140	1-1-140
1-1-141	1-1-141	1-1-141	1-1-141	1-1-141
1-1-142	1-1-142	1-1-142	1-1-142	1-1-142
1-1-150	1-1-150	1-1-150		1-1-150
1-1-154			1-1-154	1-1-154
1-1-167	1-1-167	1-1-167	1-1-167	1-1-167
1-1-169	1-1-169	1-1-169	1-1-169	1-1-169
1-1-170	1-1-170	1-1-170	1-1-170	1-1-170
1-1-172	1-1-172	1-1-172		
1-1-178	1-1-178			
1-1-182	1-1-182	1-1-182	1-1-182	1-1-182
1-1-191	1-1-191			
1-1-193			1-1-193	
1-1-194	1-1-194	1-1-194	1-1-194	1-1-194
1-1-195	1-1-195	1-1-195	1-1-195	1-1-195
1-1-204	1-1-204	1-1-204	1-1-204	1-1-204
1-1-207	1-1-207	1-1-207	1-1-207	1-1-207
1-1-209	1-1-209	1-1-209	1-1-209	1-1-209
1-1-212	1-1-212	1-1-212	1-1-212	1-1-212
1-1-216	1-1-216	1-1-216	1-1-216	1-1-216
1-1-220	1-1-220	1-1-220	1-1-220	1-1-220
1-1-225	1-1-225	1-1-225	1-1-225	1-1-225
1-1-230	1-1-230	1-1-230	1-1-230	1-1-230
1-1-234	1-1-234			
1-1-236	1-1-236			

baseline	3 month	6 month	12 month	18 month
1-1-237	1-1-237	1-1-237	1-1-237	1-1-237
1-1-242		1-1-242		
1-1-244	1-1-244			
1-1-247	1-1-247	1-1-247	1-1-247	1-1-247
1-1-248	1-1-248	1-1-248	1-1-248	1-1-248
1-1-249	1-1-249			
1-1-253	1-1-253	1-1-253		1-1-253
1-1-255	1-1-255	1-1-255	1-1-255	
1-1-256	1-1-256	1-1-256	1-1-256	1-1-256
1-1-259	1-1-259	1-1-259	1-1-259	1-1-259
1-1-261	1-1-261	1-1-261	1-1-261	
1-1-263	1-1-263	1-1-263		
1-1-267	1-1-267	1-1-267	1-1-267	
1-1-271	1-1-271	1-1-271	1-1-271	
1-1-278	1-1-278	1-1-278	1-1-278	
1-1-279	1-1-279	1-1-279		
1-2-001		1-2-001	1-2-001	1-2-001
1-2-002	1-2-002	1-2-002	1-2-002	1-2-002
1-2-003	1-2-003	1-2-003	1-2-003	1-2-003
1-2-004	1-2-004	1-2-004	1-2-004	1-2-004
1-2-007	1-2-007	1-2-007	1-2-007	1-2-007
1-2-009	1-2-009	1-2-009	1-2-009	1-2-009
1-2-014	1-2-014	1-2-014	1-2-014	1-2-014
1-2-015	1-2-015	1-2-015	1-2-015	1-2-015
1-2-016	1-2-016	1-2-016	1-2-016	1-2-016
1-2-017		1-2-017	1-2-017	1-2-017
1-2-018		1-2-018	1-2-018	1-2-018
1-2-019	1-2-019	1-2-019	1-2-019	1-2-019
1-2-020	1-2-020	1-2-020	1-2-020	1-2-020
1-2-021	1-2-021	1-2-021	1-2-021	1-2-021
1-2-023	1-2-023	1-2-023	1-2-023	1-2-023
1-2-024	1-2-024	1-2-024	1-2-024	1-2-024
1-2-025	1-2-025	1-2-025		
1-2-027				
1-3-004				
1-3-008	1-3-008			
1-3-012	1-3-012			
		1-2-027	1-2-027	
			1-3-004	1-3-004
				1-3-008
1-3-020	1-3-020	1-3-020	1-3-020	1-3-020
1-3-031	1-3-031	1-3-031	1-3-031	1-3-031
1-3-035	1-3-035	1-3-035	1-3-035	1-3-035
1-3-041	1-3-041	1-3-041	1-3-041	1-3-041
1-3-046	1-3-046	1-3-046	1-3-046	
1-3-047	1-3-047	1-3-047	1-3-047	1-3-047
14172-101	14172-101			
14172-102	14172-102	14172-102		
14172-103	14172-103			
14172-104	14172-104			
14172-105	14172-105			

baseline	3 month	6 month	12 month	18 month
14172-107	14172-107			
14173-402	14173-402			
2-1-002	2-1-002	2-1-002	2-1-002	2-1-002
2-1-014				2-1-014
2-1-023	2-1-023	2-1-023	2-1-023	2-1-023
2-1-030			2-1-030	2-1-030
2-1-037	2-1-037			
2-1-040	2-1-040	2-1-040	2-1-040	2-1-040
2-1-043	2-1-043		2-1-043	
2-1-046	2-1-046	2-1-046	2-1-046	2-1-046
2-1-047	2-1-047	2-1-047	2-1-047	2-1-047
2-1-063	2-1-063	2-1-063	2-1-063	
2-1-070		2-1-070		
2-1-071	2-1-071	2-1-071	2-1-071	
EX-1-1-012	EX-1-1-012	EX-1-1-012	EX-1-1-012	
EX-1-1-014	EX-1-1-014	EX-1-1-014	EX-1-1-014	EX-1-1-014
EX-1-1-043	EX-1-1-043	EX-1-1-043	EX-1-1-043	EX-1-1-043
EX-1-1-080	EX-1-1-080	EX-1-1-080	EX-1-1-080	EX-1-1-080
EX-1-1-085	EX-1-1-085	EX-1-1-085	EX-1-1-085	EX-1-1-085
EX-1-1-090	EX-1-1-090		EX-1-1-090	EX-1-1-090
EX-1-1-092	EX-1-1-092	EX-1-1-092	EX-1-1-092	EX-1-1-092
EX-1-1-095		EX-1-1-095	EX-1-1-095	EX-1-1-095
EX-1-1-128	EX-1-1-128			
EX-1-1-156	EX-1-1-156	EX-1-1-156	EX-1-1-156	EX-1-1-156
EX-1-1-187	EX-1-1-187	EX-1-1-187	EX-1-1-187	EX-1-1-187
EX-1-1-232		EX-1-1-232	EX-1-1-232	
EX-1-1-277	EX-1-1-277			
EX-1-2-005	EX-1-2-005	EX-1-2-005	EX-1-2-005	EX-1-2-005
EX-1-2-008			EX-1-2-008	EX-1-2-008
EX-1-2-022	EX-1-2-022	EX-1-2-022		
n=127	**n=109**	**n=93**	**n=93**	**n=82**

- Patients missing SPADI information were highlighted.
- There are 126 unique patients for 3 month, 6 month, 12 month, and 18 month visits.
- The total number of patients in final model is 124, patients 1-1-059 and 1-1-067 don't have SPADI information at any follow-up visits.

3 Linear Mixed Effect Model with Selected Variables

3.1 Selected Variables in Full Model

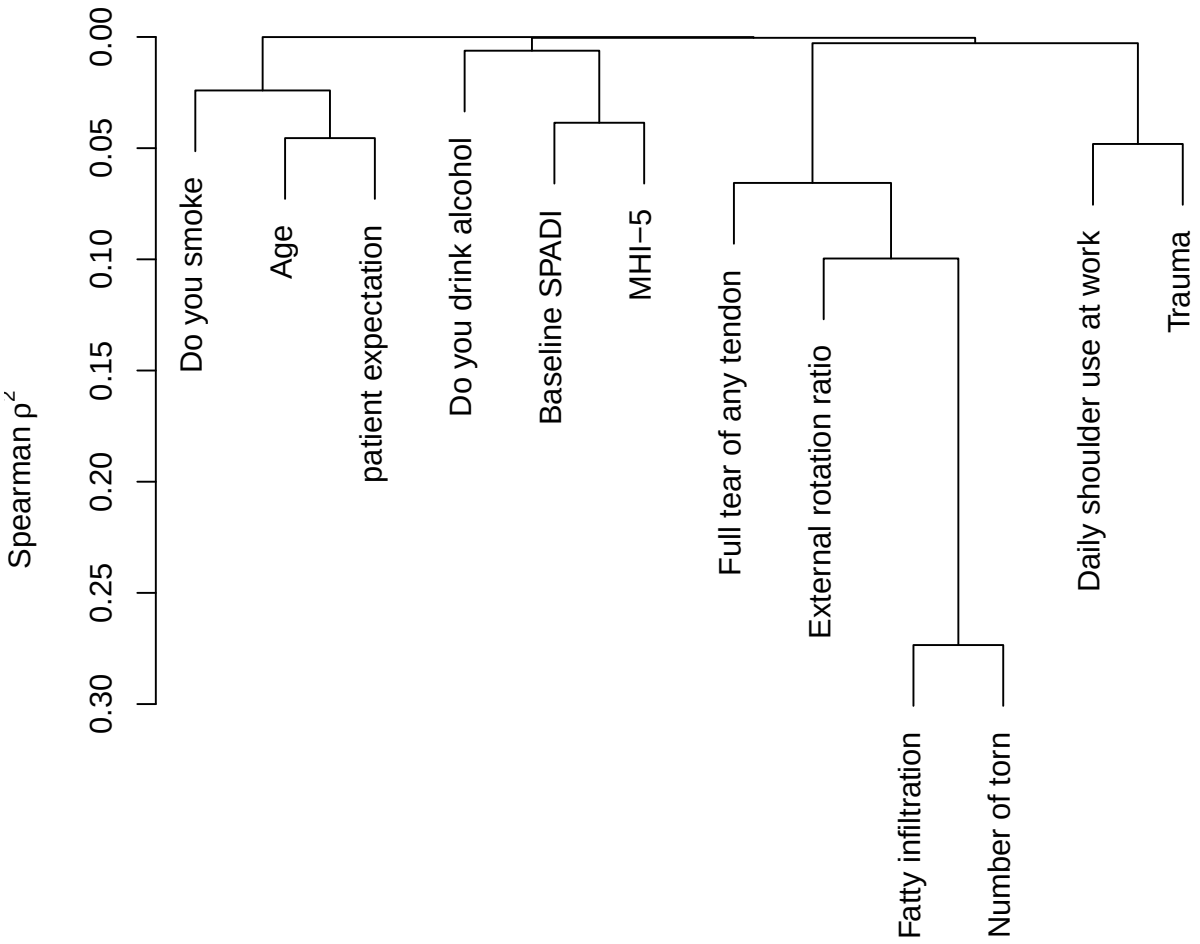
- Do you smoke
- Age
- Do you drink alcohol?
- Baseline SPADI
- External rotatio ratio
- Daily shoulder use at work
- Trauma
- Fatty infiltration
- Number of torn
- MHI-5
- Patient expectation
- Full tear of any tendons?

3.2 Redundancy Analysis for Selected Variables at Baseline

```
##
## Redundancy Analysis
##
## redun(formula = ~basespadi + pi_age + hx_f6_f + hx_e9_f + external.rotation.ratio +
##     fat_f + mhi + as.factor(torn_f) + hx_e8a_f + trauma_f + full_f +
##     hx_h1_f, data = dat1, r2 = 0.9, type = "adjusted", nk = 4)
##
## n: 81  p: 12  nk: 4
##
## Number of NAs:  46
## Frequencies of Missing Values Due to Each Variable
##               basespadi                  pi_age                hx_f6_f
##                       7                       0                       1
##                hx_e9_f external.rotation.ratio                  fat_f
##                       3                       8                      28
##                    mhi       as.factor(torn_f)               hx_e8a_f
##                       2                      17                       3
##                trauma_f                  full_f                hx_h1_f
##                       6                      17                       2
##
##
## Transformation of target variables forced to be linear
##
## R-squared cutoff: 0.9  Type: adjusted
##
## R^2 with which each variable can be predicted from all other variables:
##
##               basespadi                  pi_age                hx_f6_f
##                   0.135                   0.197                   0.052
##                hx_e9_f external.rotation.ratio                  fat_f
##                   0.085                   0.048                   0.427
##                    mhi       as.factor(torn_f)               hx_e8a_f
##                   0.134                   0.210                   0.042
##                trauma_f                  full_f                hx_h1_f
##                   0.055                   0.106                   0.000
##
## No redundant variables
```

- The predictor that can be predicted from the remaining set with the adjusted R^2 higher than 0.9 is removed.
- There is no redundant variable.

3.3 Cluster Analysis for Selected Variables at Baseline

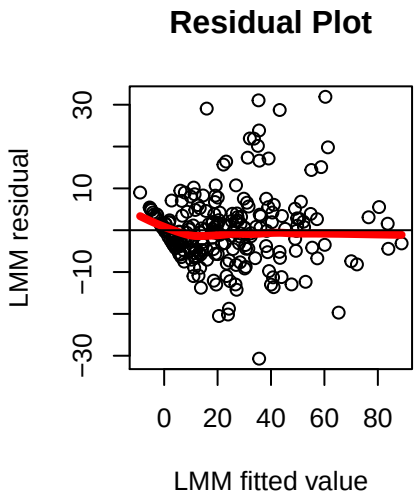


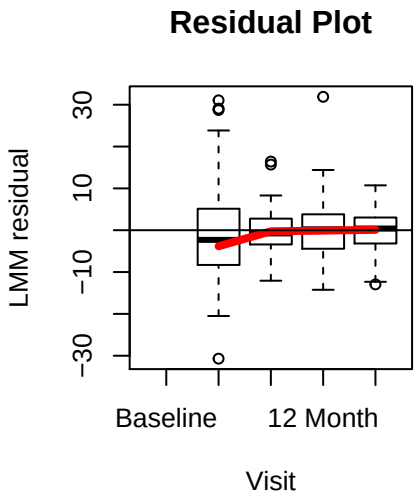
3.4 Model Fitting

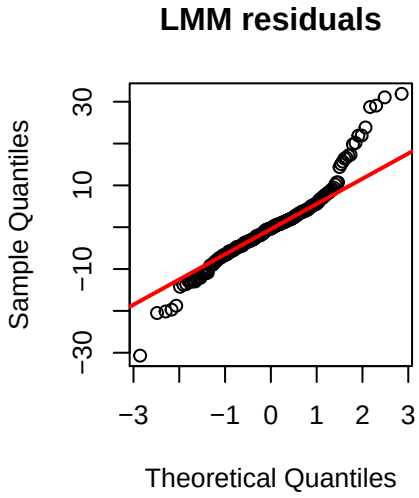
```
##                                                lower    est.  upper p.value
## (Intercept)                                    -0.84  30.290  61.42   0.068
## visit_new6 Month                              -11.35  -5.205   0.94   0.112
## visit_new12 Month                             -11.56  -4.960   1.64   0.158
## visit_new18 Month                             -18.71 -12.365  -6.02   0.000
## operative_newNon-operative                    -10.40   0.296  10.99   0.958
## basespadi                                       0.15   0.312   0.47   0.000
## pi_age                                         -0.56  -0.159   0.24   0.451
## hx_f6_fHeavy/Moderate manual labor             -2.68   4.837  12.36   0.224
## hx_e9_f1-2 times per week or more             -16.30  -9.357  -2.41   0.012
## external.rotation.ratio                        -2.88   5.309  13.50   0.220
## fat_fYes                                        7.55  15.081  22.61   0.000
## mhi                                            -0.23   0.004   0.24   0.974
## torn_f2 or 3                                   -8.73  -1.095   6.55   0.785
## hx_e8a_fPast/current                           -7.33  -0.907   5.51   0.788
## trauma_fYes                                    -8.64  -2.358   3.93   0.476
## hx_h1_fOther                                  -11.54  -2.639   6.26   0.573
## full_fYes                                     -11.36  -3.318   4.72   0.433
## visit_new6 Month:operative_newNon-operative   -24.30 -15.781  -7.26   0.001
## visit_new12 Month:operative_newNon-operative -33.69 -24.547 -15.40   0.000
## visit_new18 Month:operative_newNon-operative -26.05 -17.334  -8.62   0.000
```

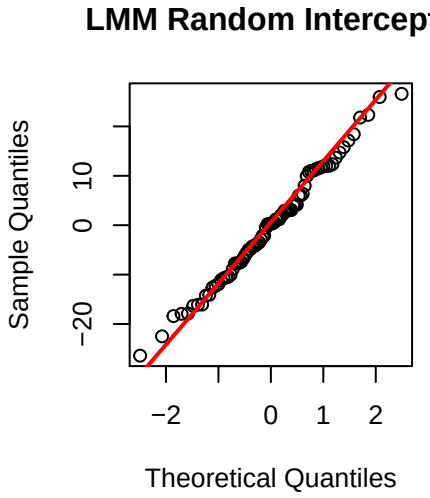
- The AIC for model with compound symmetric correlation structure is 1858.
- The AIC for model with auto-regressive correlation structure is 1859.37.
- Model with general compound symmetric correlation structure is the final model.
- Number of Observations: 232
- Number of Groups: 79

3.5 Residual Plot of Final Model









- Anderson-Darling normality test for LMM residuals is 2.25×10^{-10}.
- Anderson-Darling normality test for LMM random intercepts is 0.78.

4 Comparison of SPADI30 by Treatment

- If SPADI_30 of any follow-up visit is 1, SPADI_30_comb is 1.
- If SPADI_30 of all follow-up visits are 0, SPADI_30_comb is 0.
- If SPADI_30 is missing for all follow-up visits, SPADI_30_comb is missing.

. N is the number of non-missing values. Numbers after proportions are frequencies.

	N	Surgery $N = 50$	Non-operative $N = 77$	Combined $N = 127$
spadi_30_comb	127			
0		0.10 (5)	0.34 (26)	0.24 (31)
1		0.90 (45)	0.57 (44)	0.70 (89)
NA		0.00 (0)	0.09 (7)	0.06 (7)

```
##                 Surgery Non-operative
## SPADI_30_comb=0       5            26
## SPADI_30_comb=1      45            44
##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  m
## X-squared = 10, df = 1, p-value = 0.002
```

5 Comparison of SPADI50 by Treatment

- If SPADI_50 of any follow-up visit is 1, SPADI_50_comb is 1.
- If SPADI_50 of all follow-up visits are 0, SPADI_50_comb is 0.
- If SPADI_50 is missing for all follow-up visits, SPADI_50_comb is missing.

. N is the number of non-missing values. Numbers after proportions are frequencies.

	N	Surgery $N = 50$	Non-operative $N = 77$	Combined $N = 127$
spadi_50_comb	127			
0		0.14 (7)	0.47 (36)	0.34 (43)
1		0.86 (43)	0.44 (34)	0.61 (77)
NA		0.00 (0)	0.09 (7)	0.06 (7)

```
##                 Surgery Non-operative
## SPADI_50_comb=0       7            36
## SPADI_50_comb=1      43            34
##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  m
## X-squared = 20, df = 1, p-value = 6e-05
```