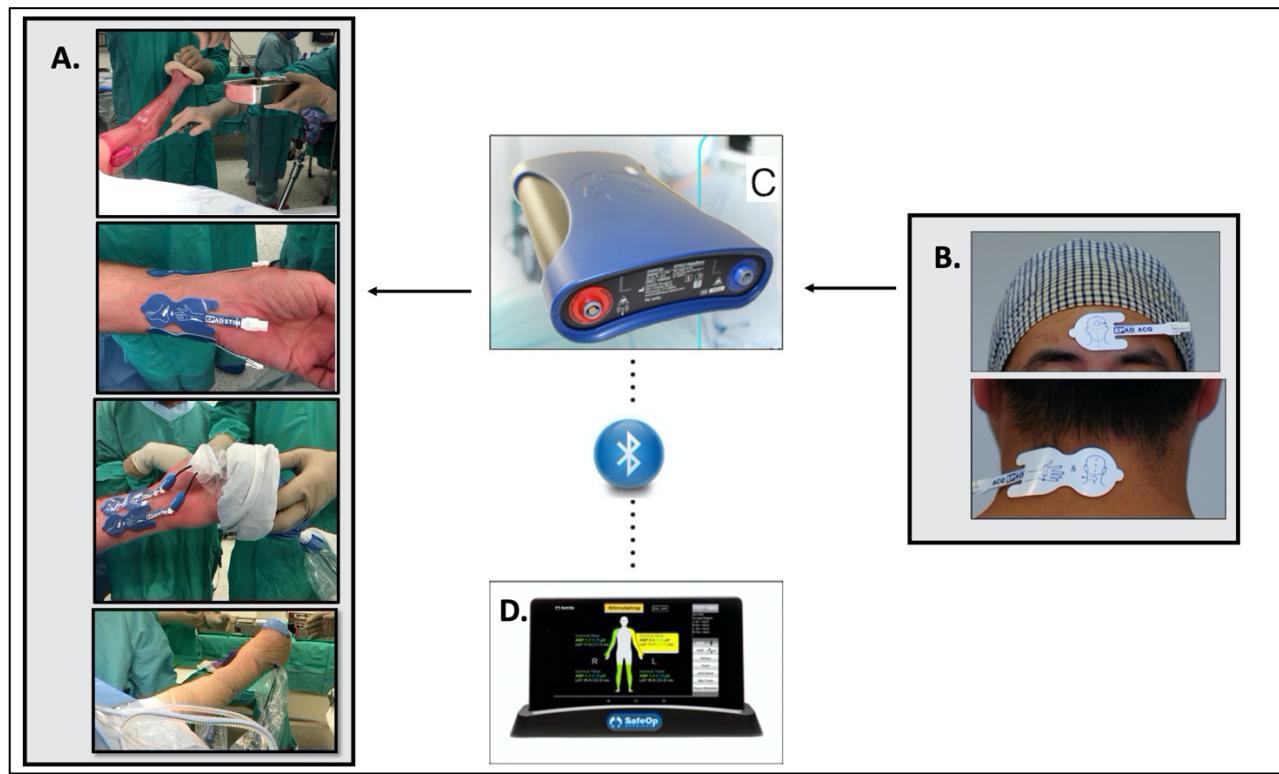
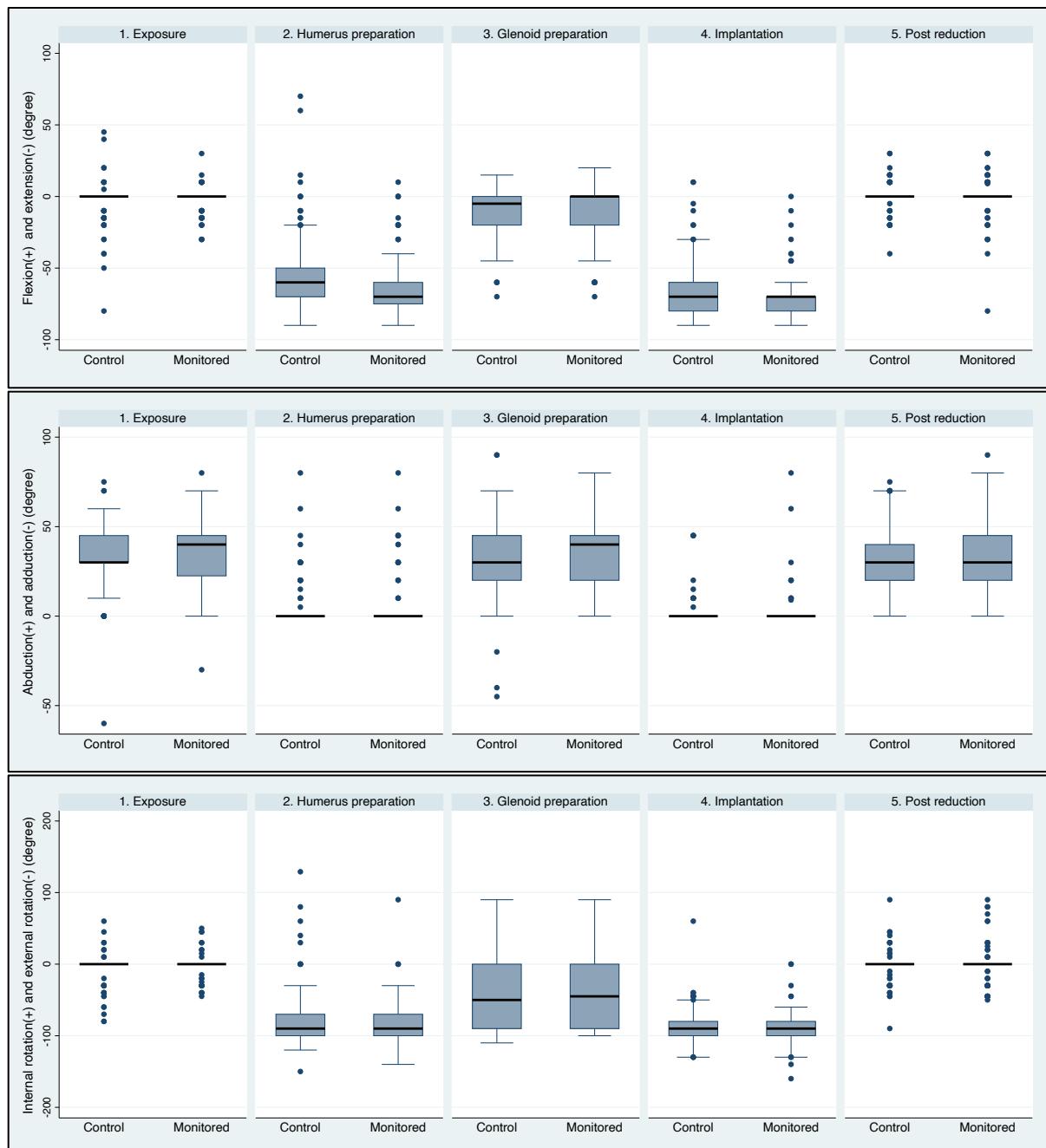


## Appendix 1. The set-up of the automated nerve monitor



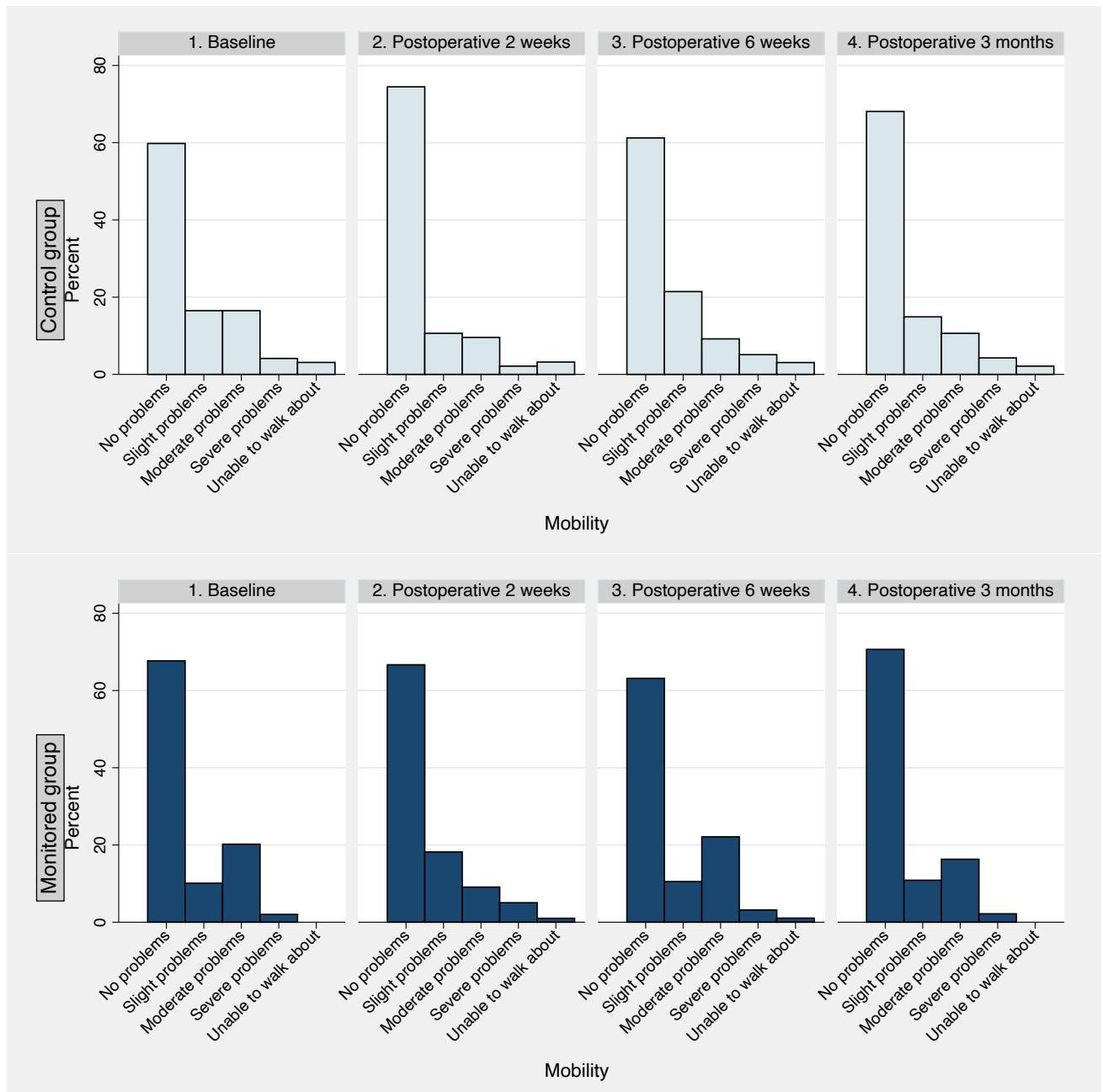
The above diagram illustrates the set-up of automated nerve monitor in shoulder arthroplasty. A) The stimulating surface electrodes are attached to median, ulnar and radial nerves at the wrist level of the operative arm. A careful surgical draping is required to maintain sterility and attachment. B) The recording surface electrode is attached to fifth cervical spine level at the posterior neck (C5) and referenced to the forehead electrode (Fz). A central control box (C) are connected to both stimulating and recording electrodes. A tablet is Bluetooth connected to the control box to record and display the nerve monitoring results. A more detailed description was previously reported.<sup>25</sup> An SSEP nerve alert was defined as either a 50% reduction in amplitude or a 10% prolongation of the latency in one of the potentials as compared with the baseline.

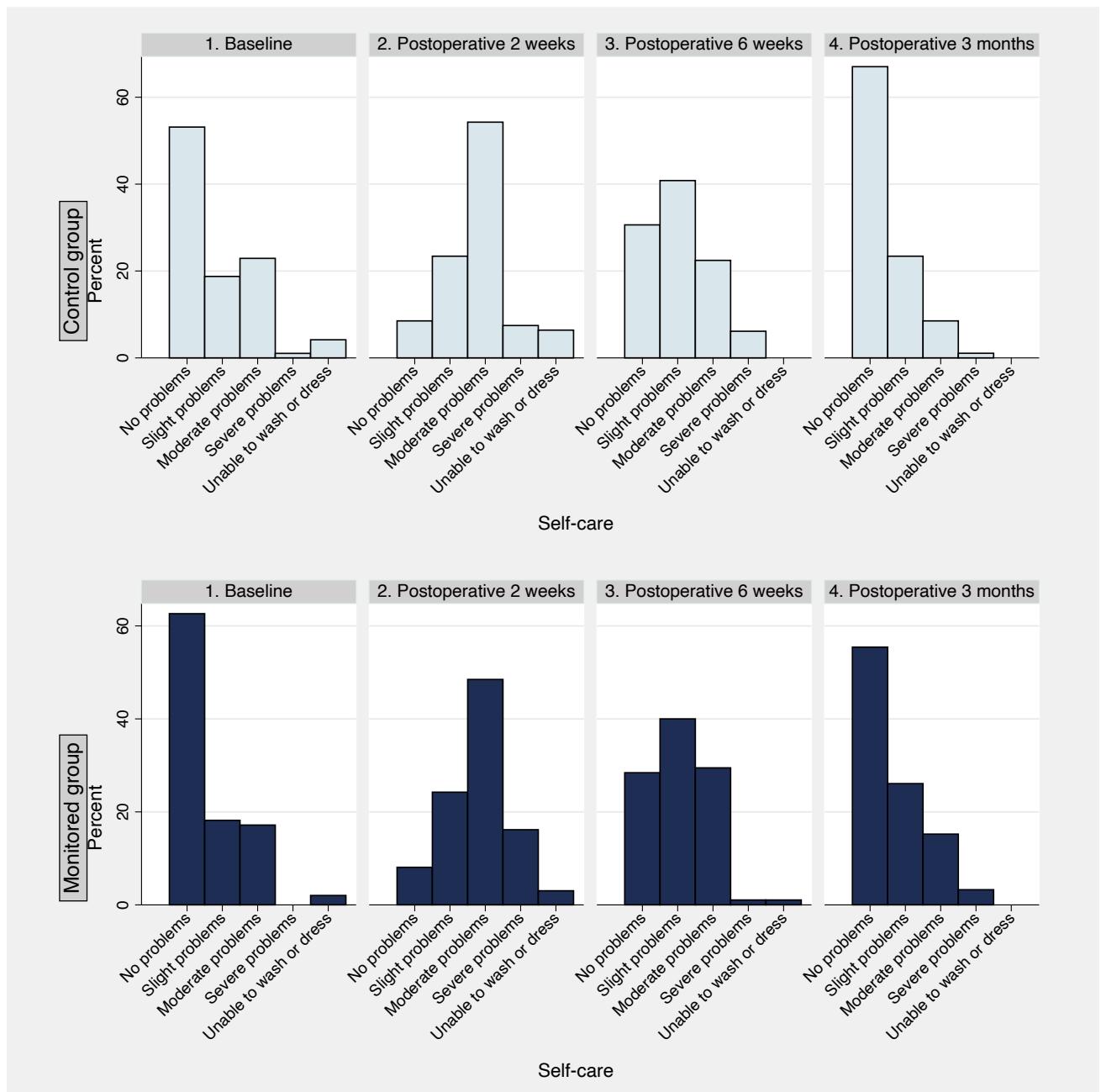
**Supplementary Fig 1. Operative arm position during total shoulder arthroplasty surgery**

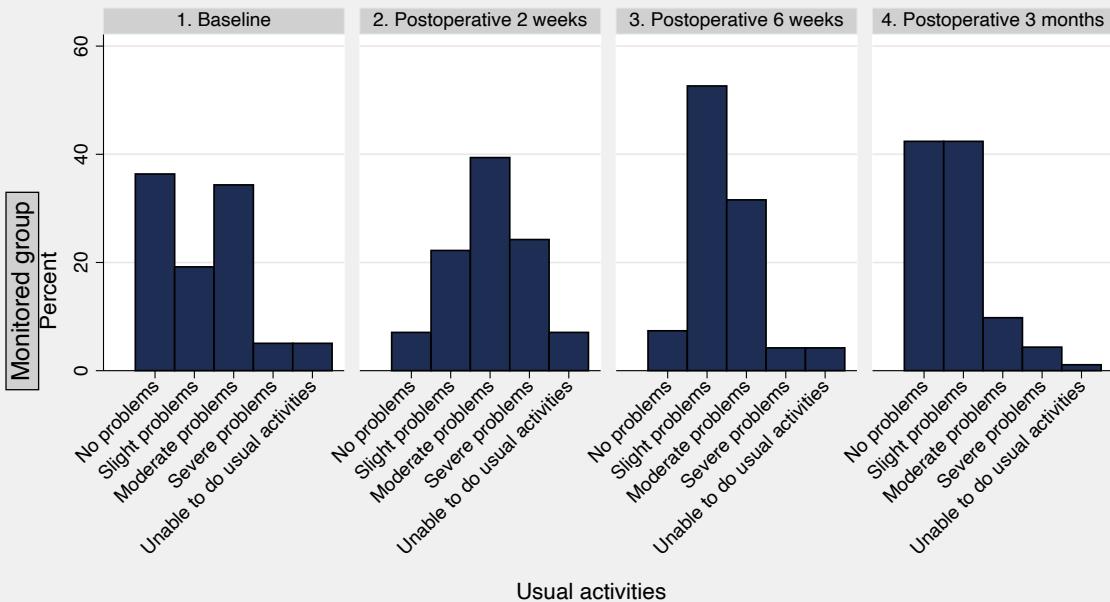
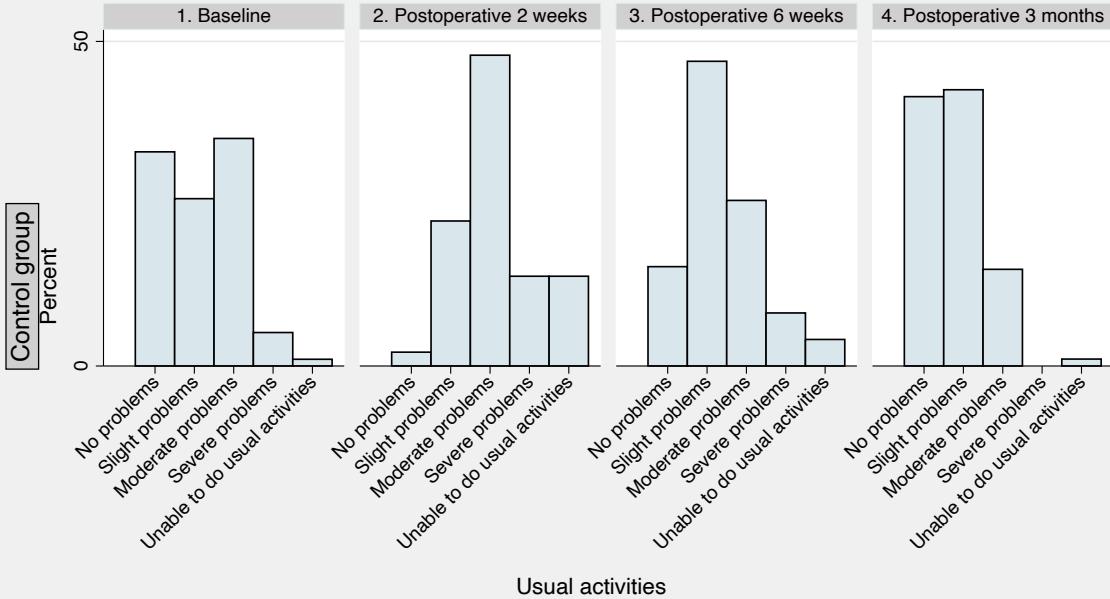


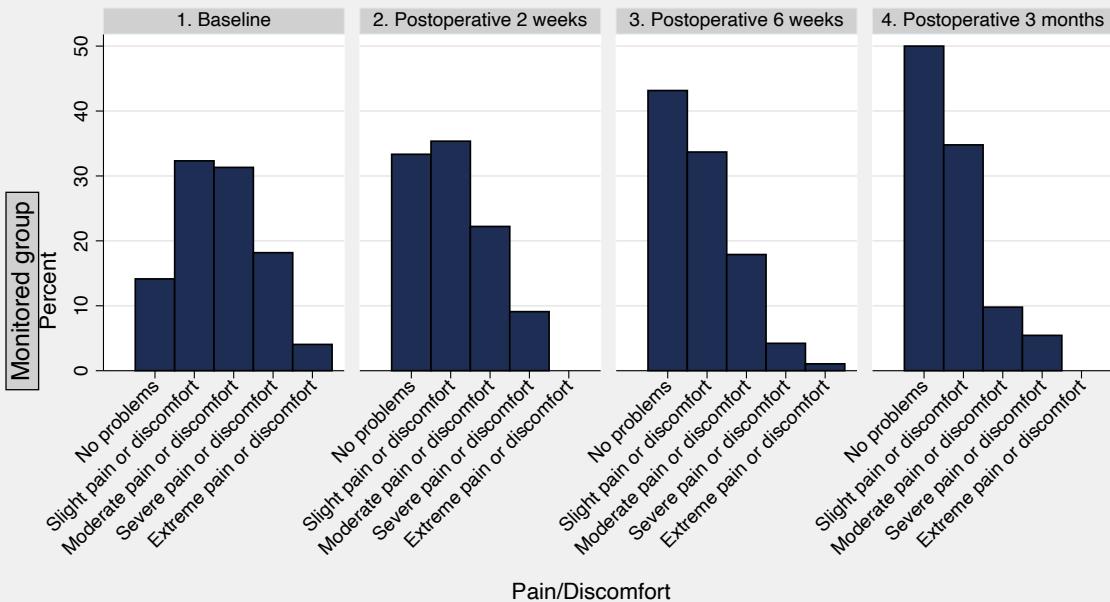
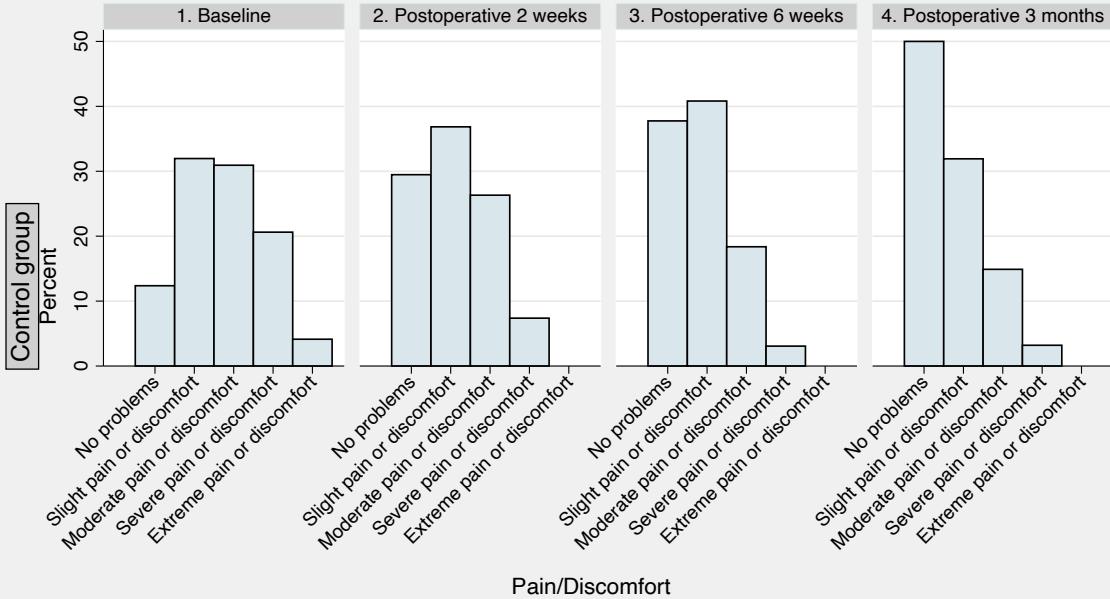
The above three panels show the operative arm position at five stages of shoulder arthroplasty surgery between control and nerve monitored group. The bottom panel shows the distribution of nerve alerts at five key stages of shoulder arthroplasty. The majority of nerve alerts occurred during glenoid preparation and implantation of shoulder arthroplasty surgery. The box represents the 25<sup>th</sup> and 75<sup>th</sup> percentile values. The thick line in the box represents the median value. The upper adjacent value represents the value of 1.5 interquartile range above the 75<sup>th</sup> percentile value. The data points above the upper adjacent lines are the outliers.

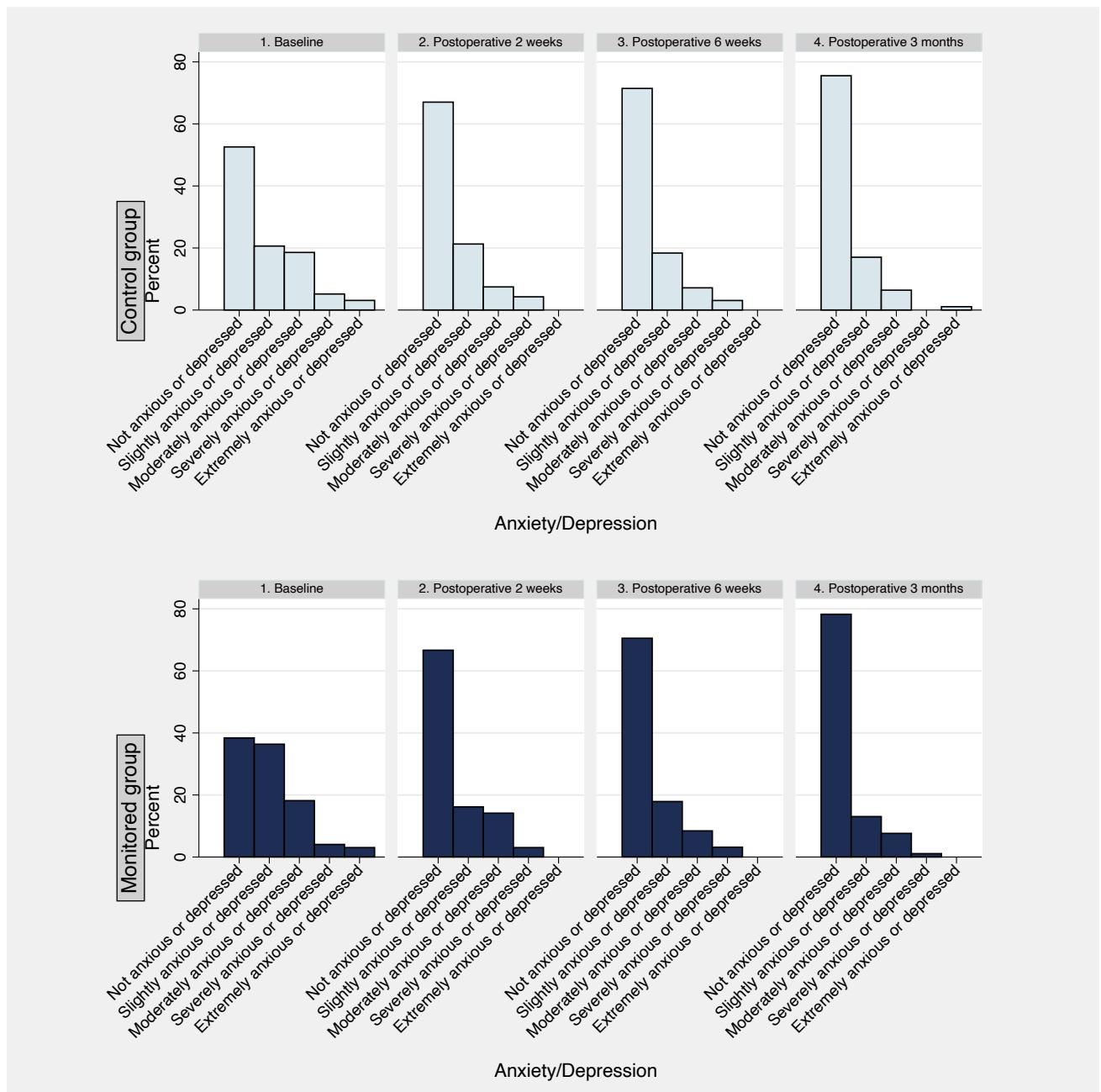
**Supplementary Fig 2. EQ-5D-5L VAS frequency distribution at baseline, postoperative 2 weeks, 6 weeks and 3 months.**



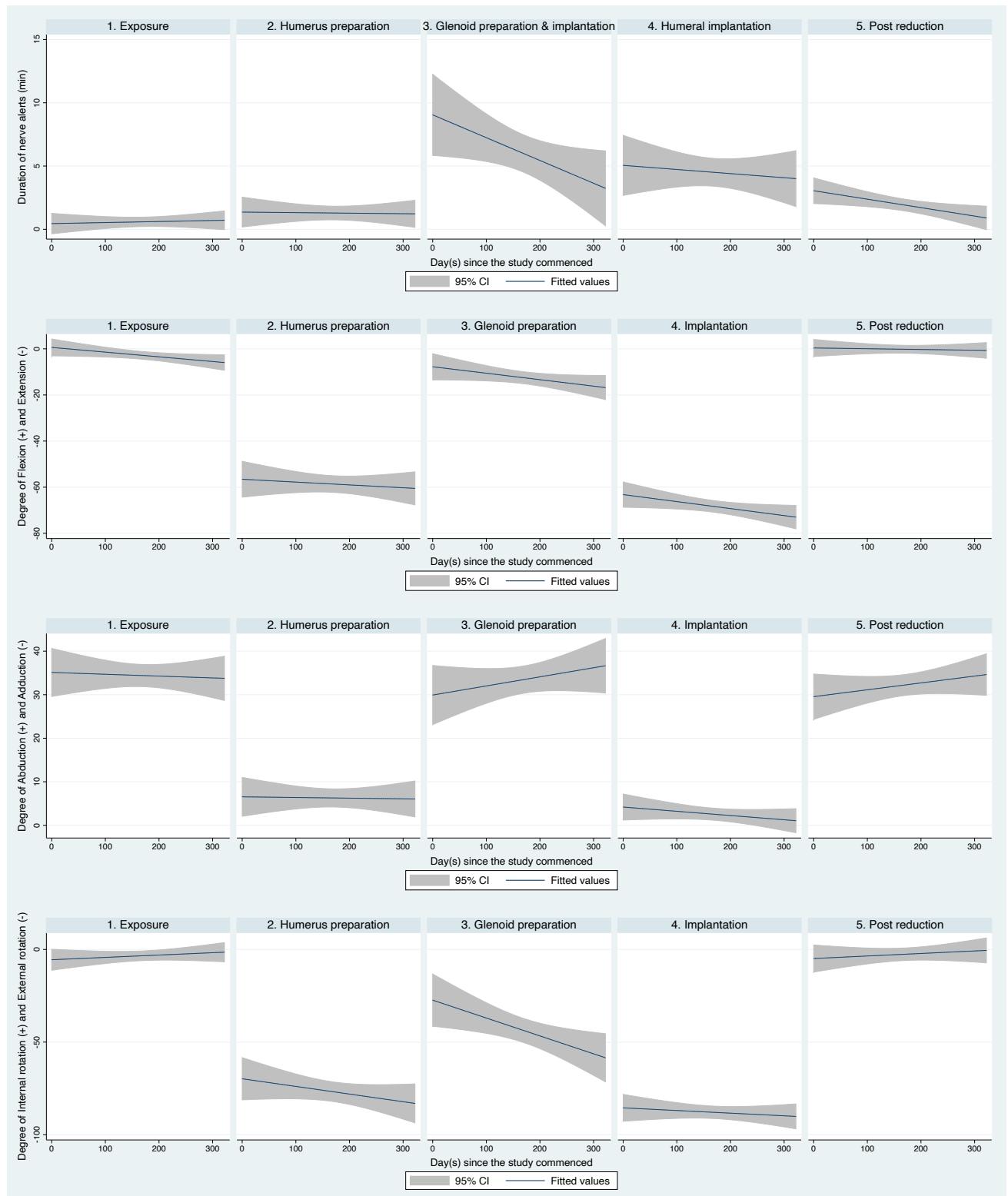


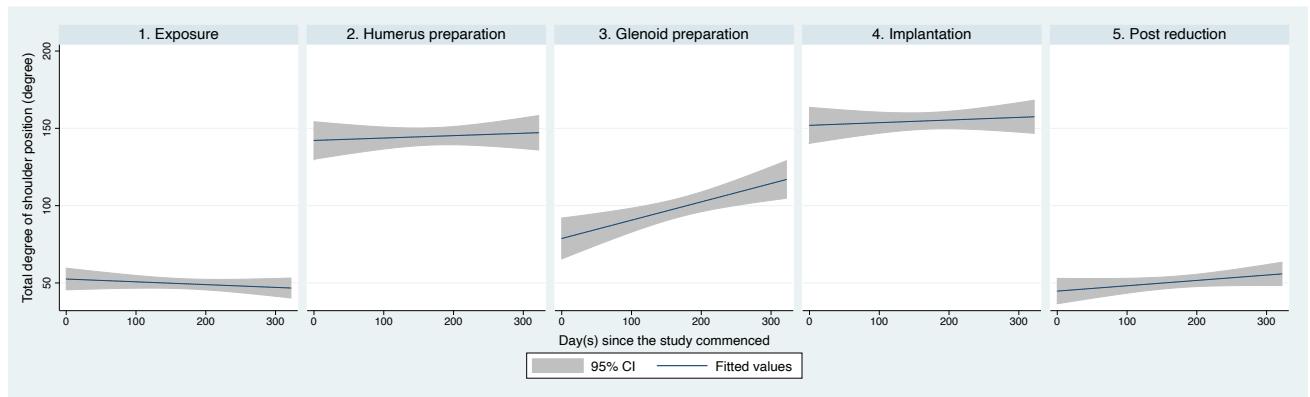






**Supplementary Fig 3. Relationship between arm position and abnormal nerve alerts against the study period in five surgical stages**





**Supplementary Table 1. Distribution of ASES Scores at baseline and at follow-up**

Dimension	Baseline N (%)		Postoperative 2 weeks follow-up N (%)		Postoperative 6 weeks follow-up N (%)		Postoperative 3 months follow-up N (%)		
	Control group	Monitored group	Control group	Monitored group	Control group	Monitored group	Control group	Monitored group	
Shoulder pain at night	87 (89)	80 (80)	48 (51)	53 (55)	35 (36)	39 (42)	31 (34)	37 (41)	
Take pain killers	65 (66)	62 (63)	56 (60)	59 (61)	41 (42)	40 (43)	28 (30)	30 (33)	
Take strong pain killers	38 (39)	42 (42)	53 (56)	59 (61)	23 (24)	24 (26)	18 (19)	20 (22)	
Intensity of pain (0-10)	23 ±11	24 ±11	3 ±3	3 ±2	2 ±2	2 ±3	2 ±2	2 ±2	
Difficult to put on a coat	U	7 (7)	4 (4)	31 (33)	33 (33)	3 (3)	1 (1)	-	1 (1)
	V	52 (53)	59 (60)	37 (39)	41 (41)	23 (24)	24 (25)	8 (9)	11 (12)
	S	31 (31)	28 (28)	23 (24)	22 (22)	50 (52)	52 (55)	44 (47)	34 (37)
	N	8 (8)	8 (8)	3 (3)	3 (3)	20 (21)	18 (19)	41 (44)	45 (50)
Difficult to sleep on the affected side	U	34 (35)	32 (32)	89 (95)	88 (91)	57 (58)	46 (49)	25 (27)	15 (16)
	V	45 (46)	39 (39)	4 (4)	6 (6)	20 (20)	18 (19)	14 (15)	14 (15)
	S	15 (15)	16 (16)	1 (1)	3 (3)	14 (14)	26 (28)	31 (33)	37 (40)
	N	4 (4)	13 (13)	-	-	7 (7)	4 (4)	23 (24)	26 (28)
Difficult to wash your back	U	55 (56)	59 (59)	45 (47)	45 (45)	23 (23)	23 (24)	14 (15)	13 (14)
	V	25 (26)	16 (16)	34 (36)	43 (43)	40 (41)	41 (43)	25 (26)	20 (21)
	S	9 (9)	16 (16)	12 (13)	9 (9)	33 (34)	28 (29)	44 (47)	42 (46)
	N	9 (9)	9 (9)	4 (4)	2 (2)	2 (2)	3 (3)	11 (12)	16 (18)
Difficult to manage toileting	U	1 (1)	6 (6)	4 (4)	4 (4)	3 (3)	1 (1)	-	1 (1)
	V	9 (9)	5 (5)	12 (13)	22 (22)	4 (4)	7 (7)	1 (1)	2 (2)
	S	17 (17)	7 (7)	33 (35)	28 (29)	28 (29)	23 (24)	14 (15)	10 (11)
	N	71 (72)	82 (82)	45 (48)	44 (45)	62 (64)	64 (67)	79 (84)	79 (86)
Difficult to comb your hair	U	34 (35)	38 (38)	31 (33)	23 (24)	11 (11)	11 (12)	8 (9)	6 (7)
	V	21 (22)	32 (32)	14 (15)	27 (28)	11 (11)	17 (18)	8 (9)	7 (8)
	S	23 (24)	9 (9)	17 (18)	18 (18)	26 (27)	26 (27)	18 (19)	17 (19)
	N	19 (20)	21 (21)	32 (34)	30 (31)	50 (51)	41 (43)	60 (64)	61 (67)
Difficult to reach a high shelf	U	52 (53)	64 (64)	91 (96)	92 (96)	60 (61)	56 (60)	16 (17)	11 (12)
	V	27 (28)	17 (17)	2 (2)	4 (4)	17 (17)	17 (18)	15 (16)	18 (20)
	S	13 (13)	15 (15)	1 (1)	-	14 (14)	12 (13)	19 (20)	24 (26)
	N	6 (6)	4 (4)	1 (1)	-	7 (7)	9 (10)	43 (46)	39 (42)
Difficult to lift 10 lbs above your shoulder	U	73 (75)	83 (83)	94 (100)	93 (99)	82 (85)	81 (86)	43 (46)	42 (36)
	V	16 (16)	11 (11)	-	1 (1)	10 (10)	10 (11)	14 (15)	16 (17)
	S	9 (9)	5 (5)	-	-	4 (4)	3 (3)	16 (17)	18 (20)
	N	-	1 (1)	-	-	1 (1)	-	21 (22)	16 (17)
Difficult to throw a ball overhand	U	66 (68)	77 (77)	94 (99)	96 (98)	79 (82)	77 (81)	41 (44)	31 (34)
	V	16 (16)	14 (14)	1 (1)	2 (2)	10 (10)	12 (13)	9 (10)	18 (20)
	S	13 (13)	5 (5)	-	-	5 (5)	5 (5)	19 (20)	18 (20)
	N	2 (2)	4 (4)	-	-	2 (2)	1 (1)	24 (26)	25 (27)
Difficult to do your usual work	U	16 (16)	20 (20)	31 (33)	21 (22)	11 (12)	8 (9)	5 (5)	6 (7)
	V	36 (37)	41 (41)	44 (46)	51 (54)	26 (27)	24 (26)	12 (13)	13 (14)
	S	34 (35)	26 (26)	18 (19)	21 (22)	55 (58)	53 (56)	44 (47)	37 (41)
	N	11 (11)	13 (13)	2 (2)	2 (2)	3 (3)	9 (10)	33 (35)	34 (38)
Difficult to do usual sport or leisure activity	U	26 (26)	37 (37)	35 (37)	25 (25)	11 (11)	12 (13)	9 (10)	7 (8)
	V	26 (27)	25 (25)	29 (31)	43 (43)	19 (20)	21 (22)	10 (11)	8 (9)
	S	32 (33)	24 (24)	23 (24)	26 (26)	52 (54)	47 (49)	33 (35)	35 (38)
	N	13 (13)	13 (13)	7 (7)	5 (5)	14 (15)	15 (16)	42 (45)	42 (46)

Abbreviation: ASES: American Shoulder and Elbow Surgeons score, U: Unable to do, V: Very difficult to do, S: Somewhat difficult to do, N: Not difficult

The ASES score is a standardized functional outcome measures in shoulder and elbow surgery. The ASES score ranged from 0 to 100 and is weighted equally for pain and function.