

## Supplemental digital contents

**Supplemental Table S1:** Patient-reported outcomes on the first day after surgery of the total cohort and the three CPSPF groups.

		All patients	No CPSPF	Mixed group	CPSPF	p
PRO-1 <sup>a</sup>	NRS	2.8 (2.7-2.9)	2.6 (2.5-2.7)	2.9 (2.8-3.1)	3.8 (3.5-4.1)	<0.001
PCS-1 <sup>b</sup>	NRS	2.6 (2.6-2.7)	2.4 (2.3-2.5)	2.8 (2.6-2.9)	3.9 (3.6-4.2)	<0.001
Worst pain	NRS	6.0 (4.0/8.0)	5.0 (3.0/7.0)	6.0 (4.0/8.0)	7.0 (5.0/8.0)	<0.001
Least pain	NRS	1.0 (0.0/2.0)	1.0 (0.0/2.0)	1.0 (0.0/2.0)	2.0 (1.0/3.0)	<0.001
% Time in severe pain	%	23.8±20.3	21.3±19.3	25.2±19.8	35.6±23.3	<0.001
PITS-1 <sup>c</sup>	NRS	2.6 (2.6-2.7)	2.4 (2.3-2.5)	2.8 (2.7-2.9)	3.3 (3.0-3.5)	<0.001
Activities in bed	NRS	5.0 (2.0/7.0)	4.0 (2.0/7.0)	5.0 (3.0/7.0)	6.0 (4.0/8.0)	<0.001
Activities out of bed <sup>d</sup>	NRS	3.0 (1.0/5.0)	3.0 (1.0/5.0)	4.0 (2.0/5.0)	5.0 (3.0/7.0)	<0.001
Breathing deeply / coughing	NRS	2.0 (0.0/5.0)	2.0 (0.0/5.0)	2.0 (0.0/5.0)	2.0 (0.0/6.0)	0.175
Sleep	NRS	2.0 (0.0/5.0)	2.0 (0.0/4.0)	3.0 (1.0/5.0)	4.0 (1.0/7.0)	<0.001
Pain-related anxiety	NRS	1.0 (0.0/4.0)	1.0 (0.0/3.0)	2.0 (0.0/4.0)	2.0 (0.0/5.0)	<0.001
Pain-related helplessness	NRS	1.0 (0.0/4.0)	1.0 (0.0/3.0)	2.0 (0.0/4.0)	2.0 (0.0/6.0)	<0.001
Side effects composite score <sup>e</sup>	NRS	2.1 (2.0-2.2)	2.0 (1.9-2.0)	2.3 (2.2-2.5)	2.5 (2.2-2.8)	<0.001
Dizziness	NRS	1.0 (0.0/4.0)	1.0 (0.0/3.0)	2.0 (0.0/4.0)	1.0 (0.0/4.0)	<0.001
Drowsiness	NRS	2.0 (0.0/5.0)	2.0 (0.0/5.0)	3.0 (1.0/5.0)	2.0 (1.0/6.0)	<0.001
Nausea	NRS	1.0 (0.0/5.0)	1.0 (0.0/4.0)	1.0 (0.0/5.0)	1.0 (0.0/4.0)	0.007
Itching	NRS	0.0 (0.0/0.0)	0.0 (0.0/0.0)	0.0 (0.0/1.0)	0.0 (0.0/1.75)	<0.001
% pain relief	%	71.4± 25.1	73.6±23.3	69.1±24.5	65.2± 25.6	<0.001
Desire more pain treatment	n (%)	215 (9.4)	102 (7.6)	77 (10.4)	36 (18.3)	<0.001

NRS as median (IQR); % as mean±SD; patients as n (%); a: PRO-1 (Composite score Patient Reported Outcomes at the first postoperative day): mean of PCS-1 and PITS-1;

b: PCS-1 (Pain Composite Score first postoperative day) = worst pain \* (% time in severe pain / 100) + least pain \* (1 - % time in severe pain / 100);

c: PITS-1 (Pain Interference Total Score at the first day after surgery) = mean of pain-related interference of activities in bed, breathing deeply/coughing, sleep and pain-related anxiety and helplessness;

d: only patients who had left bed (n=1886); e: side effects composite score of dizziness, drowsiness, nausea, and itching.

The PAIN OUT questionnaire available in 31 languages can be downloaded from the PAIN OUT homepage (<http://pain-out.med.uni-jena.de/downloads>).

**Supplemental Table S2:** Results of the multivariable ordinal regression analysis with CPSPF group as dependent three-stage variable including pre- and perioperative variables.

Variables	OR	95% CI	p
Sex: female vs. male (reference)	1.314	1.050; 1.644	0.017
Age years	0.996	0.989; 1.003	0.234
Weight kg	0.992	0.987; 0.997	0.001
Pre-existing chronic pain: yes vs. no (reference)	1.636	1.332; 2.009	<0.001
Opioids before admission: yes vs. no (reference)	1.846	1.239; 2.750	0.003
Type of surgery: General surgery (reference)	1.0		
Orthopedic surgery	2.572	1.965; 3.366	<0.001
Gynecology	1.474	1.125; 1.932	0.005
Neurosurgery (spine surgery)	2.437	1.268; 4.684	0.008
Others <sup>d</sup>	0.819	0.446; 1.504	0.520
Spine surgery: yes vs. no (reference)	1.273	0.752; 2.155	0.370
Number of comorbidities	0.986	0.886; 1.096	0.789
Cancer: yes vs. no (reference)	1.287	0.969; 1.710	0.081
Smoking: yes vs. no (reference)	1.020	0.780; 1.325	0.883
Alcohol: yes vs. no (reference)	1.012	0.582; 1.761	0.966
Substance abuse: yes vs. no (reference)	0.766	0.376; 1.561	0.463
Perioperative opioid administration: yes vs. no (reference)			
Intraoperative preventive	1.343	1.075; 1.678	0.010
Opioids in the PACU	1.494	1.214; 1.839	<0.001
Opioids on the ward	1.009	0.825; 1.234	0.930
Perioperative administration of nonopioid analgesics: yes vs. no (reference)			
Preventive nonopioid analgesics	0.743	0.605; 0.914	0.005
Nonopioid analgesics in the PACU	0.570	0.456; 0.713	<0.001
Nonopioid analgesics on the ward	0.956	0.648; 1.411	0.821
Regional analgesia: yes vs. no (reference) <sup>a</sup>	1.118	0.894; 1.397	0.328
PRO-1 score NRS	1.204	1.129; 1.285	<0.001
Desire for more pain treatment: yes vs. no (reference)	1.239	0.905; 1.695	0.181

n=2212; Nagelkerkes R<sup>2</sup>: 0.193; OR: Odds ratio; 95% CI: 95% confidence interval; a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

**Supplemental Table S3 A: Orthopedic surgery;** results of the multivariable linear regression analysis including pre- and perioperative variables. Dependent variable is patient-reported pain-related outcome 12 months after surgery (PRO-12 score).

Variables		Regression coefficient	95% CI	p
Sex: female vs. male (reference)		-0.004	-0.310; 0.301	0.978
Age	years	-0.005	-0.015; 0.005	0.327
Weight	kg	0.003	-0.006; 0.011	0.509
Pre-existing chronic pain: yes vs. no (reference)		0.533	0.222; 0.845	0.001
Opioids before admission: yes vs. no (reference)		0.623	0.147; 1.099	0.010
Spine surgery: yes vs. no (reference)		0.657	0.181; 1.132	0.007
Number of comorbidities		-0.040	-0.181; 0.101	0.577
Cancer: yes vs. no (reference)		-0.294	-0.965; 0.376	0.390
Smoking: yes vs. no (reference)		0.299	-0.092; 0.690	0.135
Alcohol: yes vs. no (reference)		0.221	-0.489; 0.931	0.543
Substance abuse: yes vs. no (reference)		-0.541	-1.397; 0.315	0.216
Perioperative administration of opioids				
Intraoperative preventive opioids: yes vs. no (reference)		0.238	-0.057; 0.533	0.114
PACU: yes vs. no (reference)		0.365	0.053; 0.676	0.022
Ward: yes vs. no (reference)		0.087	-0.217; 0.391	0.575
Perioperative administration of nonopioid analgesics				
Intraoperative: yes vs. no (reference)		-0.401	-0.715; -0.088	0.012
PACU: yes vs. no (reference)		-0.186	-0.515; 0.143	0.269
Ward: yes vs. no (reference)		-0.037	-0.818; 0.744	0.927
Regional analgesia: yes vs. no (reference) <sup>a</sup>		0.254	-0.088; 0.597	0.145
PRO-1 score	NRS	0.154	0.057; 0.251	0.002
Desire for more pain treatment: yes vs. no (reference)		0.453	-0.037; 0.943	0.070

R<sup>2</sup>=0.133; 95% CI: 95% confidence interval. a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

**Supplemental Table S3 B: General surgery;** results of the multivariable linear regression analysis including pre- and perioperative variables. Dependent variable is patient-reported pain-related outcome 12 months after surgery (PRO-12 score).

Variables		Regression coefficient	95% CI	p
Sex: female vs. male (reference)		0.162	-0.014; 0.338	0.072
Age	years	0.000	-0.007; 0.007	0.936
Weight	kg	-0.001	-0.004; 0.003	0.651
Pre-existing chronic pain: yes vs. no (reference)		0.172	-0.011; 0.356	0.066
Opioids before admission: yes vs. no (reference)		1.559	1.049; 2.070	<0.001
Number of comorbidities		-0.044	-0.135; 0.046	0.337
Cancer: yes vs. no (reference)		-0.113	-0.374; 0.148	0.396
Smoking: yes vs. no (reference)		0.043	-0.183; 0.268	0.711
Alcohol: yes vs. no (reference)		-0.159	-0.658; 0.340	0.533
Substance abuse: yes vs. no (reference)		0.458	-0.158; 1.074	0.145
Perioperative administration of opioids				
Intraoperative preventive opioids: yes vs. no (reference)		0.356	0.134; 0.577	0.002
PACU: yes vs. no (reference)		0.049	-0.147; 0.246	0.623
Ward: yes vs. no (reference)		-0.066	-0.245; 0.113	0.471
Perioperative administration of nonopioid analgesics				
Intraoperative: yes vs. no (reference)		-0.094	-0.282; 0.095	0.332
PACU: yes vs. no (reference)		-0.234	-0.468; 0.001	0.051
Ward: yes vs. no (reference)		0.131	-0.198; 0.461	0.434
Regional analgesia: yes vs. no (reference) <sup>a</sup>		0.162	-0.028; 0.351	0.095
PRO-1 score	NRS	0.070	0.008; 0.131	0.027
Desire for more pain treatment: yes vs. no (reference)		0.175	-0.122; 0.473	0.248

R<sup>2</sup>=0.080; 95% CI: 95% confidence interval. a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

**Supplemental Table S3 C: Gynecological/obstetric surgery**, results of the multivariable linear regression analysis including pre- and perioperative variables. Dependent variable is patient-reported pain-related outcome 12 months after surgery (PRO-12 score).

Variables		Regression coefficient	95% CI	p
Age	years	-0.006	-0.014; 0.003	0.191
Weight	kg	-0.005	-0.011; 0.001	0.110
Pre-existing chronic pain: yes vs. no (reference)		0.557	0.313; 0.801	<0.001
Opioids before admission: yes vs. no (reference)		-0.189	-0.876; 0.498	0.590
Number of comorbidities		0.284	0.130; 0.437	<0.001
Cancer: yes vs. no (reference)		-0.204	-0.474; 0.065	0.138
Smoking: yes vs. no (reference)		-0.299	-0.638; 0.039	0.083
Alcohol: yes vs. no (reference)		-0.007	-0.814; 0.801	0.987
Substance abuse: yes vs. no (reference)		-0.804	-2.429; 0.820	0.332
Perioperative administration of opioids				
Intraoperative preventive opioids: yes vs. no (reference)		-0.167	-0.475; 0.141	0.287
PACU: yes vs. no (reference)		0.228	0.023; 0.433	0.029
Ward: yes vs. no (reference)		0.097	-0.120; 0.315	0.382
Perioperative administration of nonopioid analgesics				
Intraoperative: yes vs. no (reference)		-0.101	-0.343; 0.141	0.412
PACU: yes vs. no (reference)		-0.199	-0.425; 0.028	0.086
Ward: yes vs. no (reference)		0.227	-0.139; 0.594	0.224
Regional analgesia: yes vs. no (reference) <sup>a</sup>		-0.395	-0.668; -0.123	0.004
PRO-1 score	NRS	0.084	0.013; 0.155	0.021
Desire for more pain treatment: yes vs. no (reference)		0.109	-0.231; 0.448	0.531

R<sup>2</sup>=0.103; 95% CI: 95% confidence interval. a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

**Supplemental Table S3 D: Neurosurgery** (spine surgery only), results of the multivariable linear regression analysis including pre- and perioperative variables. Dependent variable is patient-reported pain-related outcome 12 months after surgery (PRO-12 score).

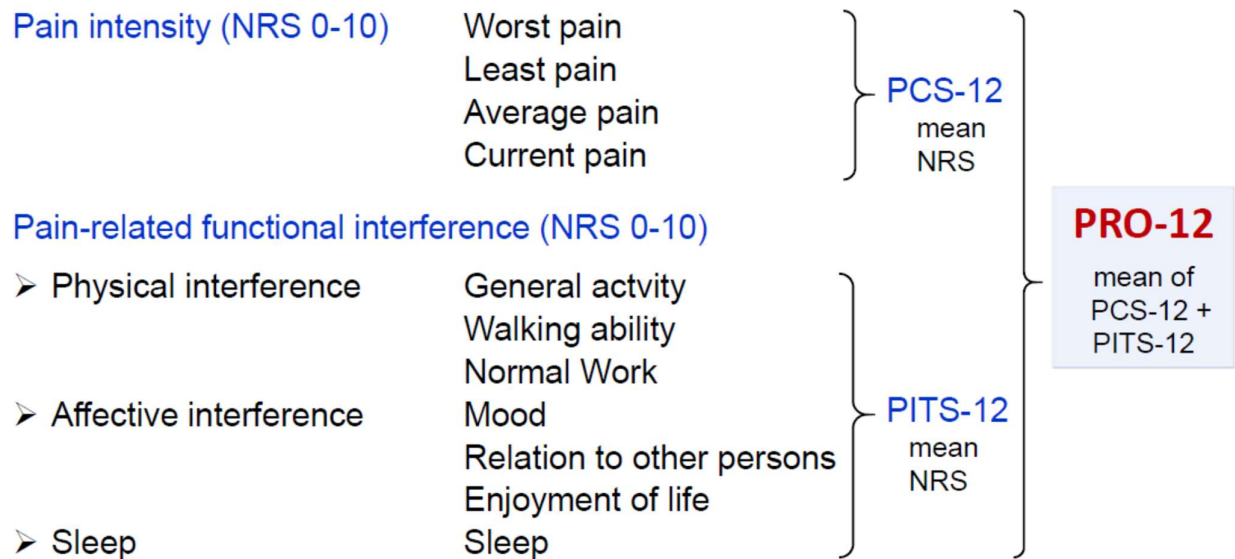
Variables		Regression coefficient	95% CI	p
Sex: female vs. male (reference)		0.288	-0.335; 0.911	0.364
Age	years	-0.008	-0.034; 0.017	0.517
Weight	kg	0.000	-0.020; 0.020	0.995
Pre-existing chronic pain: yes vs. no (reference)		0.287	-0.426; 1.001	0.430
Opioids before admission: yes vs. no (reference)		1.364	0.568; 2.160	0.001
Number of comorbidities		0.143	-0.231; 0.518	0.453
Cancer: yes vs. no (reference)		0.918	-0.572; 2.409	0.227
Smoking: yes vs. no (reference)		0.673	-0.125; 1.472	0.098
Alcohol: yes vs. no (reference)		-0.198	-2.128; 1.731	0.840
Substance abuse: yes vs. no (reference)		-1.539	-4.789; 1.711	0.353
Perioperative administration of opioids				
Intraoperative preventive opioids: yes vs. no (reference)		0.240	-0.451; 0.930	0.496
PACU: yes vs. no (reference)		0.062	-0.606; 0.730	0.856
Ward: yes vs. no (reference)		-0.126	-0.830; 0.577	0.725
Perioperative administration of nonopioid analgesics				
Intraoperative: yes vs. no (reference)		0.316	-0.436; 1.069	0.410
PACU: yes vs. no (reference)		-1.140	-2.069; -0.211	0.016
Ward: yes vs. no (reference)		0.469	-0.846; 1.785	0.484
Regional analgesia: yes vs. no (reference) <sup>a</sup>				
PRO-1 score	NRS	0.361	0.166; 0.555	<0.001
Desire for more pain treatment: yes vs. no (reference)		0.350	-0.777; 1.477	0.543

R<sup>2</sup>=0.320; 95% CI: 95% confidence interval. a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

**Supplemental Table S3 E:** Results of the multivariable linear regression analysis including perioperative variables for one single hospital.

Variables	Regression coefficient	95% CI	p
Sex: female vs. male (reference)	0.113	-0.057; 0.284	0.193
Age years	-0.002	-0.007; 0.004	0.594
Weight kg	-0.001	-0.004; 0.002	0.540
Pre-existing chronic pain: yes vs. no (reference)	0.510	0.342; 0.678	<0.001
Opioids before admission: yes vs. no (reference)	0.968	0.660; 1.276	<0.001
Type of surgery: General surgery (reference)			
Orthopedic surgery	0.467	0.252; 0.682	<0.001
Gynecology	0.140	-0.078; 0.359	0.209
Neurosurgery (spine surgery)	0.183	-0.303; 0.669	0.461
Others	-0.060	-0.775; 0.655	0.869
Spine surgery: yes vs. no (reference)	0.456	0.061; 0.851	0.024
Number of comorbidities	-0.002	-0.082; 0.078	0.961
Cancer: yes vs. no (reference)	0.113	-0.117; 0.343	0.336
Smoking: yes vs. no (reference)	0.200	0.000; 0.400	0.049
Alcohol: yes vs. no (reference)	-0.094	-0.545; 0.357	0.684
Substance abuse: yes vs. no (reference)	-0.200	-0.697; 0.297	0.430
Perioperative administration of opioids			
Intraoperative preventive opioids: yes vs. no (reference)	0.246	0.069; 0.423	0.007
PACU: yes vs. no (reference)	0.185	0.020; 0.350	0.028
Ward: yes vs. no (reference)	-0.065	-0.224; 0.093	0.418
Perioperative administration of nonopioid analgesics			
Intraoperative: yes vs. no (reference)	-0.146	-0.314; 0.022	0.089
PACU: yes vs. no (reference)	-0.273	-0.492; -0.055	0.014
Ward: yes vs. no (reference)	0.166	-0.245; 0.578	0.428
Regional analgesia: yes vs. no (reference) <sup>a</sup>	0.072	-0.110; 0.254	0.436
PRO-1 score NRS	0.108	0.058; 0.159	<0.001
Desire for more pain treatment: yes vs. no (reference)	0.197	-0.059; 0.453	0.132

R<sup>2</sup>:0.177; 95% CI: 95% confidence interval. a: regional analgesia includes neuraxial anesthesia and peripheral nerve blocks either performed intraoperatively only, postoperatively or during both time intervals.

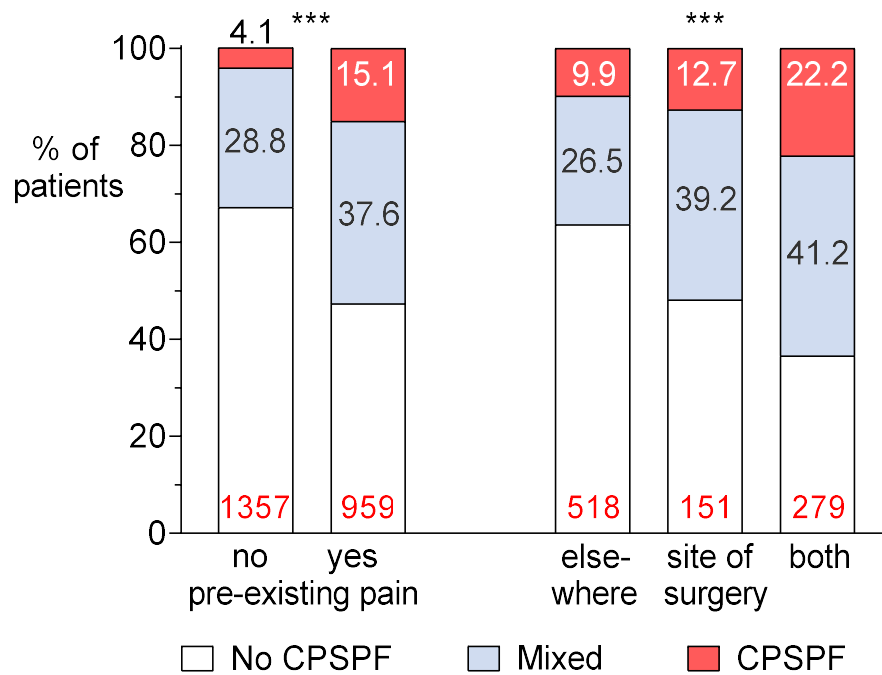


**Supplemental Figure S1:** Measures based on the BPI (Brief Pain Inventory short form) used 12 months after surgery to calculate composite scores. All measures are NRS 0-10.

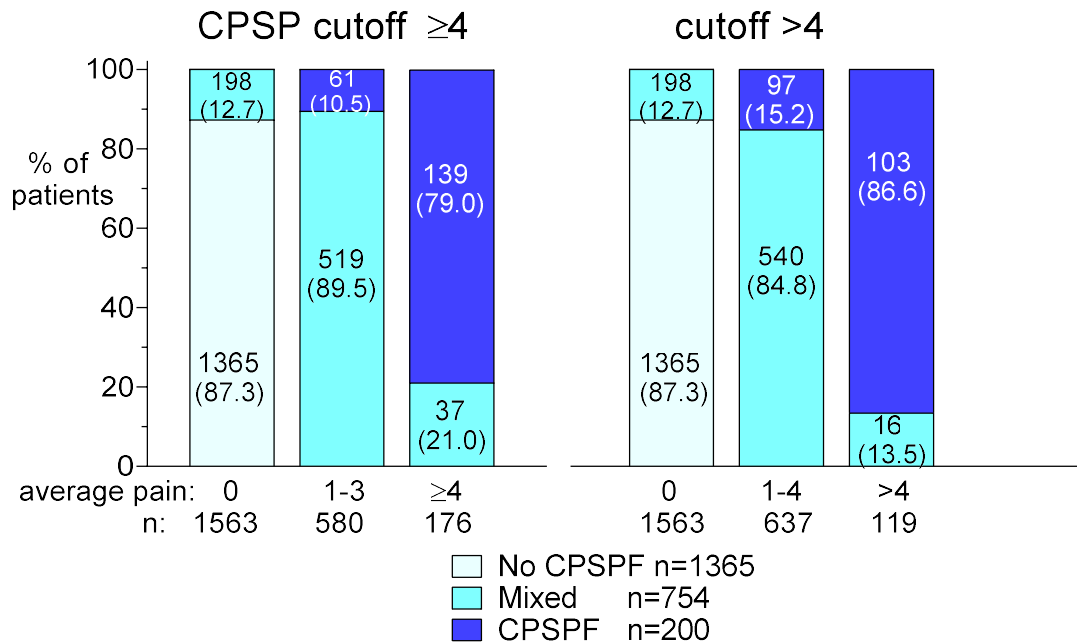
PCS-12 (Pain Composite Score) 12 months after surgery: mean of 4 items

PITS-12 (Pain Interference Total Score) 12 months after surgery: mean of 7 items

PRO-12 (Patient-Reported Outcome) score 12 months after surgery: mean of PCS-12 + PITS-12



**Supplemental Figure S2:** Percent of patients allocated to the groups *No CPSPF*, *Mixed* and *CPSPF* at 12 months, differentiated for subgroups without and with pre-existing chronic pain before surgery and for subgroups having pre-existing pain at the site of surgery, elsewhere or at the site of surgery and elsewhere (both). Red numbers at the bottom of the columns indicate the number of patients in the respective group. \*\*\* p <0.001.



**Supplemental Figure S3:** Percent of patients allocated to the groups *No CPSPF*, *Mixed* and *CPSPF* differentiated for CPSP groups (displayed on the x-axis) build by average pain scores at 12 months using a cutoff of NRS  $\geq 4$  or NRS  $> 4$ ;  $p < 0.001$ .

With increasing cutoffs to be used for allocation to group CPSP, less patients of the *Mixed* group and more patients of group *CPSPF* remain in the CPSP group.

	Percent of patients in Group CPSP allocated to ...	
	Group <i>Mixed</i>	Group <i>CPSPF</i>
using a cutoff of NRS $> 0$ :	73.5%	26.5%
using a cutoff of NRS $\geq 3$ :	40.2%	59.8%
using a cutoff of NRS $\geq 4$ :	21.0%	79.0%
using a cutoff of NRS $> 4$ :	13.5%	86.5%