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Inventor(s) Malinowski; Zdzislaw Bernard

Interspinous spacer with a range of deployment positions and methods and systems

Abstract

An interspinous spacer includes a body having a channel and at least one slot; an arm actuator defining a threaded channel; an actuator screw including a shaft with a threaded distal portion partially disposed in the channel of the body and the threaded channel of the arm actuator; a first pin arranged to move along the slot of the body; a second pin; and first and second arms, each having a coupling extension that defines a pin opening and a curved track. The first and second arms are coupled to the body by the second pin extending through the curved tracks and further coupled to the body and the actuator arm by the first pin extending through the pin openings. The first and second arms rotate among different deployment positions according to the curved track in response to longitudinal movement of the actuator arm as the actuator screw is rotated.

Inventors: **Malinowski; Zdzislaw Bernard (Castaic, CA)**

Applicant: **Boston Scientific Neuromodulation Corporation** (Valencia, CA)

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Assignee: **Boston Scientific Neuromodulation Corporation (Valencia, CA)**

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References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
2248054	12/1940	Becker	N/A	N/A
2677369	12/1953	Knowles	N/A	N/A
2933114	12/1959	Bystrom	N/A	N/A
3242120	12/1965	Steuber	N/A	N/A
3486505	12/1968	Morrison	N/A	N/A
3648691	12/1971	Lumb et al.	N/A	N/A
3780733	12/1972	Martinez-Manzor	N/A	N/A
3986383	12/1975	Petteys	N/A	N/A
4545374	12/1984	Jacobson	N/A	N/A
4632101	12/1985	Freeland	N/A	N/A
4685447	12/1986	Iversen et al.	N/A	N/A
4799484	12/1988	Smith et al.	N/A	N/A
4863476	12/1988	Sheppard	N/A	N/A
4877020	12/1988	Vich	N/A	N/A
4895564	12/1989	Farrell	N/A	N/A
4986831	12/1990	King et al.	N/A	N/A
5011484	12/1990	Breard	N/A	N/A
5015247	12/1990	Michelson	N/A	N/A
5019081	12/1990	Watanabe	N/A	N/A
5040542	12/1990	Gray	N/A	N/A
5059193	12/1990	Kuslich	N/A	N/A
5092866	12/1991	Breard et al.	N/A	N/A
5178628	12/1992	Otsuka et al.	N/A	N/A
5180393	12/1992	Commarmond	N/A	N/A
5182281	12/1992	Frigola-Constansa et al.	N/A	N/A
5188281	12/1992	Fujiwara et al.	N/A	N/A
5192281	12/1992	de la Caffiniere	N/A	N/A

5195526	12/1992	Michelson	N/A	N/A
5238295	12/1992	Harrell	N/A	N/A
5298253	12/1993	LeFiles et al.	N/A	N/A
5368594	12/1993	Martin et al.	N/A	N/A
5390683	12/1994	Pisharodi	N/A	N/A
5415661	12/1994	Holmes	N/A	N/A
5456722	12/1994	McLeod et al.	N/A	N/A
5462738	12/1994	LeFiles et al.	N/A	N/A
5472452	12/1994	Trott	N/A	N/A
5484437	12/1995	Michelson	N/A	N/A
5487739	12/1995	Aebischer et al.	N/A	N/A
5489308	12/1995	Kuslich et al.	N/A	N/A
5496318	12/1995	Howland et al.	N/A	N/A
5531748	12/1995	de la Caffiniere	N/A	N/A
5549679	12/1995	Kuslich	N/A	N/A
5571189	12/1995	Kuslich	N/A	N/A
5591165	12/1996	Jackson	N/A	N/A
5609634	12/1996	Voydeville	N/A	N/A
5609636	12/1996	Kohrs et al.	N/A	N/A
5645599	12/1996	Samani	N/A	N/A
5654599	12/1996	Casper	N/A	N/A
5658335	12/1996	Allen	N/A	N/A
5658337	12/1996	Kohrs et al.	N/A	N/A
5674295	12/1996	Ray et al.	N/A	N/A
5700264	12/1996	Zucherman et al.	N/A	N/A
5725582	12/1997	Bevan et al.	N/A	N/A
5741253	12/1997	Michelson	N/A	N/A
5746720	12/1997	Stouder, Jr.	N/A	N/A
5762629	12/1997	Kambin	N/A	N/A
5836948	12/1997	Zucherman et al.	N/A	N/A
5860977	12/1998	Zucherman et al.	N/A	N/A
5863948	12/1998	Epstein et al.	N/A	N/A
5876404	12/1998	Zucherman et al.	N/A	N/A
RE36211	12/1998	Nonomura	N/A	N/A
5904636	12/1998	Chen	N/A	N/A
5904686	12/1998	Zucherman et al.	N/A	N/A
5928207	12/1998	Pisano et al.	N/A	N/A
5948017	12/1998	Taheri	N/A	N/A
5972015	12/1998	Scribner et al.	N/A	N/A
6039761	12/1999	Li et al.	N/A	N/A
6045552	12/1999	Zucherman et al.	N/A	N/A
6048342	12/1999	Zucherman et al.	N/A	N/A
6048345	12/1999	Berke et al.	N/A	N/A
6066154	12/1999	Reiley et al.	N/A	N/A
6068630	12/1999	Zucherman et al.	N/A	N/A
6074390	12/1999	Zucherman et al.	N/A	N/A
6080155	12/1999	Michelson	N/A	N/A
6080157	12/1999	Cathro et al.	N/A	N/A
6090112	12/1999	Zucherman et al.	N/A	N/A
6096038	12/1999	Michelson	N/A	N/A

6102928	12/1999	Bonutti	N/A	N/A
6102950	12/1999	Vaccaro	N/A	N/A
D433193	12/1999	Gaw et al.	N/A	N/A
6132464	12/1999	Martin	N/A	N/A
6149642	12/1999	Gerhart et al.	N/A	N/A
6149652	12/1999	Zucherman et al.	N/A	N/A
6152926	12/1999	Zucherman et al.	N/A	N/A
6156038	12/1999	Zucherman et al.	N/A	N/A
6159215	12/1999	Urbahns et al.	N/A	N/A
6179873	12/2000	Zientek	N/A	N/A
6183471	12/2000	Zucherman et al.	N/A	N/A
6190387	12/2000	Zucherman et al.	N/A	N/A
6225048	12/2000	Soderberg-Naucler et al.	N/A	N/A
6235030	12/2000	Zucherman et al.	N/A	N/A
6238397	12/2000	Zucherman et al.	N/A	N/A
6264651	12/2000	Underwood et al.	N/A	N/A
6264656	12/2000	Michelson	N/A	N/A
6267763	12/2000	Castro	N/A	N/A
6267765	12/2000	Taylor et al.	N/A	N/A
6270498	12/2000	Michelson	N/A	N/A
6280444	12/2000	Zucherman et al.	N/A	N/A
6312431	12/2000	Asfora	N/A	N/A
6328730	12/2000	Harkrider, Jr.	N/A	N/A
6332882	12/2000	Zucherman et al.	N/A	N/A
6332883	12/2000	Zucherman et al.	N/A	N/A
6336930	12/2001	Stalcup et al.	N/A	N/A
6348053	12/2001	Cachia	N/A	N/A
6364883	12/2001	Santilli	N/A	N/A
6371989	12/2001	Chauvin et al.	N/A	N/A
6375682	12/2001	Fleischmann et al.	N/A	N/A
6379355	12/2001	Zucherman et al.	N/A	N/A
6387130	12/2001	Stone et al.	N/A	N/A
6395032	12/2001	Gauchet	N/A	N/A
6402740	12/2001	Ellis et al.	N/A	N/A
6402750	12/2001	Atkinson et al.	N/A	N/A
6402784	12/2001	Wardlaw	N/A	N/A
6413228	12/2001	Hung et al.	N/A	N/A
6419676	12/2001	Zucherman et al.	N/A	N/A
6419677	12/2001	Zucherman et al.	N/A	N/A
6440169	12/2001	Elberg et al.	N/A	N/A
6443988	12/2001	Felt et al.	N/A	N/A
6447547	12/2001	Michelson	N/A	N/A
6451019	12/2001	Zucherman et al.	N/A	N/A
6451020	12/2001	Zucherman et al.	N/A	N/A
6464682	12/2001	Snoke	N/A	N/A
6471976	12/2001	Taylor et al.	N/A	N/A
6478796	12/2001	Zucherman et al.	N/A	N/A
6478822	12/2001	Leroux et al.	N/A	N/A
6500178	12/2001	Zucherman et al.	N/A	N/A

6514256	12/2002	Zucherman et al.	N/A	N/A
6530925	12/2002	Boudard et al.	N/A	N/A
6558333	12/2002	Gilboa et al.	N/A	N/A
6565570	12/2002	Sterett et al.	N/A	N/A
6572617	12/2002	Senegas	N/A	N/A
6575981	12/2002	Boyd et al.	N/A	N/A
6579281	12/2002	Palmer et al.	N/A	N/A
6579319	12/2002	Goble et al.	N/A	N/A
6582433	12/2002	Yun	N/A	N/A
6582451	12/2002	Marucci et al.	N/A	N/A
6599292	12/2002	Ray	N/A	N/A
6602248	12/2002	Sharps et al.	N/A	N/A
6610065	12/2002	Branch et al.	N/A	N/A
6610091	12/2002	Reiley	N/A	N/A
6616673	12/2002	Stone et al.	N/A	N/A
6626944	12/2002	Taylor	N/A	N/A
6645207	12/2002	Dixon et al.	N/A	N/A
6645211	12/2002	Magana	N/A	N/A
6652527	12/2002	Zucherman et al.	N/A	N/A
6652534	12/2002	Zucherman et al.	N/A	N/A
6663637	12/2002	Dixon et al.	N/A	N/A
6679886	12/2003	Weikel et al.	N/A	N/A
6695842	12/2003	Zucherman et al.	N/A	N/A
6699246	12/2003	Zucherman et al.	N/A	N/A
6699247	12/2003	Zucherman et al.	N/A	N/A
6702847	12/2003	Dicarlo	N/A	N/A
6712819	12/2003	Zucherman et al.	N/A	N/A
6716215	12/2003	David et al.	N/A	N/A
6716245	12/2003	Pasquel et al.	N/A	N/A
6723126	12/2003	Berry	606/247	A61F 2/4455
6726690	12/2003	Eckman	N/A	N/A
6733534	12/2003	Sherman	N/A	N/A
6746485	12/2003	Zucherman et al.	N/A	N/A
6761720	12/2003	Senegas	N/A	N/A
6783529	12/2003	Hover et al.	N/A	N/A
6783546	12/2003	Zucherman et al.	N/A	N/A
6796983	12/2003	Zucherman et al.	N/A	N/A
6805697	12/2003	Helm et al.	N/A	N/A
6835205	12/2003	Atkinson et al.	N/A	N/A
6840944	12/2004	Suddaby	N/A	N/A
6858029	12/2004	Yeh	N/A	N/A
6869398	12/2004	Obenchain et al.	N/A	N/A
6875212	12/2004	Shaolian et al.	N/A	N/A
6902566	12/2004	Zucherman et al.	N/A	N/A
6926728	12/2004	Zucherman et al.	N/A	N/A
6946000	12/2004	Senegas et al.	N/A	N/A
6949123	12/2004	Reiley	N/A	N/A
6966930	12/2004	Amin et al.	N/A	N/A
6974478	12/2004	Reiley et al.	N/A	N/A

6976988	12/2004	Ralph et al.	N/A	N/A
7011685	12/2005	Arnin et al.	N/A	N/A
7029473	12/2005	Zucherman et al.	N/A	N/A
7033358	12/2005	Taylor et al.	N/A	N/A
7048736	12/2005	Robinson et al.	N/A	N/A
7070598	12/2005	Lim et al.	N/A	N/A
7083649	12/2005	Zucherman et al.	N/A	N/A
7087055	12/2005	Lim et al.	N/A	N/A
7087083	12/2005	Pasquel et al.	N/A	N/A
7097648	12/2005	Globerman et al.	N/A	N/A
7101375	12/2005	Zucherman et al.	N/A	N/A
7163558	12/2006	Senegas et al.	N/A	N/A
7179225	12/2006	Shluzas et al.	N/A	N/A
7187064	12/2006	Tzu et al.	N/A	N/A
7189234	12/2006	Zucherman et al.	N/A	N/A
7189236	12/2006	Taylor et al.	N/A	N/A
7201751	12/2006	Zucherman et al.	N/A	N/A
7217291	12/2006	Zucherman et al.	N/A	N/A
7223289	12/2006	Trieu et al.	N/A	N/A
7229441	12/2006	Trieu et al.	N/A	N/A
7238204	12/2006	Le Couedic et al.	N/A	N/A
7252673	12/2006	Lim	N/A	N/A
7273496	12/2006	Mitchell	N/A	N/A
7282063	12/2006	Cohen et al.	N/A	N/A
7297162	12/2006	Mujwid	N/A	N/A
7306628	12/2006	Zucherman et al.	N/A	N/A
7318839	12/2007	Malberg et al.	N/A	N/A
7320707	12/2007	Zucherman et al.	N/A	N/A
7335200	12/2007	Carli	N/A	N/A
7335203	12/2007	Winslow et al.	N/A	N/A
7354453	12/2007	McAfee	N/A	N/A
7384340	12/2007	Eguchi et al.	N/A	N/A
7390330	12/2007	Harp	N/A	N/A
7410501	12/2007	Michelson	N/A	N/A
7442208	12/2007	Mathieu et al.	N/A	N/A
7445637	12/2007	Taylor	N/A	N/A
7473268	12/2008	Zucherman et al.	N/A	N/A
7476251	12/2008	Zucherman et al.	N/A	N/A
7481839	12/2008	Zucherman et al.	N/A	N/A
7481840	12/2008	Zucherman et al.	N/A	N/A
7491204	12/2008	Marnay et al.	N/A	N/A
7497859	12/2008	Zucherman et al.	N/A	N/A
7503935	12/2008	Zucherman et al.	N/A	N/A
7504798	12/2008	Kawada et al.	N/A	N/A
7510567	12/2008	Zucherman et al.	N/A	N/A
7520887	12/2008	Maxy et al.	N/A	N/A
7520899	12/2008	Zucherman et al.	N/A	N/A
7547308	12/2008	Bertagnoli et al.	N/A	N/A
7549999	12/2008	Zucherman et al.	N/A	N/A
7550009	12/2008	Amin et al.	N/A	N/A

7565259	12/2008	Sheng et al.	N/A	N/A
7572276	12/2008	Lim et al.	N/A	N/A
7575600	12/2008	Zucherman et al.	N/A	N/A
7585313	12/2008	Kwak et al.	N/A	N/A
7585316	12/2008	Trieu	N/A	N/A
7588588	12/2008	Spitler et al.	N/A	N/A
7591851	12/2008	Winslow et al.	N/A	N/A
7601170	12/2008	Winslow et al.	N/A	N/A
7621939	12/2008	Zucherman et al.	N/A	N/A
7635377	12/2008	Zucherman et al.	N/A	N/A
7635378	12/2008	Zucherman et al.	N/A	N/A
7637950	12/2008	Baccelli et al.	N/A	N/A
7658752	12/2009	Labrom et al.	N/A	N/A
7662187	12/2009	Zucherman et al.	N/A	N/A
7666186	12/2009	Harp	N/A	N/A
7666209	12/2009	Zucherman et al.	N/A	N/A
7666228	12/2009	Le Couedic et al.	N/A	N/A
7670377	12/2009	Zucherman et al.	N/A	N/A
7682376	12/2009	Trieu	N/A	N/A
7691146	12/2009	Zucherman et al.	N/A	N/A
7695513	12/2009	Zucherman et al.	N/A	N/A
7699852	12/2009	Frankel et al.	N/A	N/A
7699873	12/2009	Stevenson et al.	N/A	N/A
D618796	12/2009	Cantu	N/A	N/A
7727233	12/2009	Blackwell et al.	N/A	N/A
7727241	12/2009	Gorensek et al.	N/A	N/A
7731751	12/2009	Butler et al.	N/A	N/A
7742795	12/2009	Stone et al.	N/A	N/A
7749231	12/2009	Bonvallet et al.	N/A	N/A
7749252	12/2009	Zucherman et al.	N/A	N/A
7749253	12/2009	Zucherman et al.	N/A	N/A
7753938	12/2009	Aschmann et al.	N/A	N/A
7758619	12/2009	Zucherman et al.	N/A	N/A
7758647	12/2009	Amin et al.	N/A	N/A
7763028	12/2009	Lim et al.	N/A	N/A
7763050	12/2009	Winslow et al.	N/A	N/A
7763051	12/2009	Labrom et al.	N/A	N/A
7763073	12/2009	Hawkins et al.	N/A	N/A
7763074	12/2009	Altarac et al.	N/A	N/A
7766967	12/2009	Francis	N/A	N/A
7776090	12/2009	Winslow et al.	N/A	N/A
7780709	12/2009	Bruneau et al.	N/A	N/A
7789898	12/2009	Peterman	N/A	N/A
7794476	12/2009	Wisnewski	N/A	N/A
7803190	12/2009	Zucherman et al.	N/A	N/A
7806911	12/2009	Peckham	N/A	N/A
7811308	12/2009	Amin et al.	N/A	N/A
7811322	12/2009	Amin et al.	N/A	N/A
7811323	12/2009	Amin et al.	N/A	N/A
7811324	12/2009	Amin et al.	N/A	N/A

7811330	12/2009	Amin et al.	N/A	N/A
7819921	12/2009	Grotz	N/A	N/A
7828822	12/2009	Zucherman et al.	N/A	N/A
7828849	12/2009	Lim	N/A	N/A
7833272	12/2009	Amin et al.	N/A	N/A
7837687	12/2009	Harp	N/A	N/A
7837688	12/2009	Boyer et al.	N/A	N/A
7837700	12/2009	Harp	N/A	N/A
7837711	12/2009	Bruneau et al.	N/A	N/A
7837734	12/2009	Zucherman et al.	N/A	N/A
7846183	12/2009	Blain	N/A	N/A
7846185	12/2009	Carls et al.	N/A	N/A
7846186	12/2009	Taylor	N/A	N/A
7857815	12/2009	Zucherman et al.	N/A	N/A
7862569	12/2010	Zucherman et al.	N/A	N/A
7862586	12/2010	Malek	N/A	N/A
7862590	12/2010	Lim et al.	N/A	N/A
7862592	12/2010	Peterson et al.	N/A	N/A
7862615	12/2010	Carli et al.	N/A	N/A
7867276	12/2010	Matge et al.	N/A	N/A
7871426	12/2010	Chin et al.	N/A	N/A
7896879	12/2010	Solsberg et al.	N/A	N/A
7942830	12/2010	Solsberg et al.	N/A	N/A
7955392	12/2010	Dewey et al.	N/A	N/A
7985246	12/2010	Trieu et al.	N/A	N/A
8012207	12/2010	Kim	N/A	N/A
8025684	12/2010	Garcia-Bengochea et al.	N/A	N/A
8057513	12/2010	Kohm et al.	N/A	N/A
8062332	12/2010	Cunningham et al.	N/A	N/A
8100823	12/2011	Harp	N/A	N/A
8123782	12/2011	Altarac et al.	N/A	N/A
8123807	12/2011	Kim	N/A	N/A
8128662	12/2011	Altarac et al.	N/A	N/A
8152837	12/2011	Altarac et al.	N/A	N/A
8167944	12/2011	Kim	N/A	N/A
8226690	12/2011	Altarac et al.	N/A	N/A
8273108	12/2011	Altarac et al.	N/A	N/A
8277488	12/2011	Altarac et al.	N/A	N/A
8292922	12/2011	Altarac et al.	N/A	N/A
8317864	12/2011	Kim	N/A	N/A
8409282	12/2012	Kim	N/A	N/A
8425559	12/2012	Tebbe et al.	N/A	N/A
8523909	12/2012	Hess	606/248	A61B 17/7065
8608762	12/2012	Solsberg et al.	N/A	N/A
8613747	12/2012	Altarac et al.	N/A	N/A
8628574	12/2013	Altarac et al.	N/A	N/A
8696671	12/2013	Solsberg et al.	N/A	N/A
8734477	12/2013	Solsberg et al.	N/A	N/A

8740948	12/2013	Reglos et al.	N/A	N/A
8845726	12/2013	Tebbe et al.	N/A	N/A
8864828	12/2013	Altarac et al.	N/A	N/A
8882772	12/2013	Solsberg et al.	N/A	N/A
8894653	12/2013	Solsberg et al.	N/A	N/A
8900271	12/2013	Kim	N/A	N/A
8945183	12/2014	Altarac et al.	N/A	N/A
9023084	12/2014	Kim	N/A	N/A
9039742	12/2014	Altarac et al.	N/A	N/A
9119680	12/2014	Altarac et al.	N/A	N/A
9125692	12/2014	Kim	N/A	N/A
9155570	12/2014	Altarac et al.	N/A	N/A
9155572	12/2014	Altarac et al.	N/A	N/A
9161783	12/2014	Altarac et al.	N/A	N/A
9186186	12/2014	Reglos et al.	N/A	N/A
9211146	12/2014	Kim	N/A	N/A
9283005	12/2015	Tebbe et al.	N/A	N/A
9314279	12/2015	Kim	N/A	N/A
9393055	12/2015	Altarac et al.	N/A	N/A
9445843	12/2015	Altarac et al.	N/A	N/A
9532812	12/2016	Altarac et al.	N/A	N/A
9572603	12/2016	Altarac et al.	N/A	N/A
9675303	12/2016	Choi	N/A	N/A
9861398	12/2017	Altarac et al.	N/A	N/A
9956011	12/2017	Altarac et al.	N/A	N/A
10058358	12/2017	Altarac et al.	N/A	N/A
10080587	12/2017	Altarac et al.	N/A	N/A
10166047	12/2018	Altarac et al.	N/A	N/A
10258479	12/2018	Stewart et al.	N/A	N/A
10524772	12/2019	Choi et al.	N/A	N/A
10610267	12/2019	Altarac et al.	N/A	N/A
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10835295	12/2019	Altarac et al.	N/A	N/A
10835297	12/2019	Altarac et al.	N/A	N/A
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11229461	12/2021	Altarac et al.	N/A	N/A
2001/0031965	12/2000	Zucherman et al.	N/A	N/A
2002/0022856	12/2001	Johnson et al.	N/A	N/A
2002/0042607	12/2001	Palmer et al.	N/A	N/A
2002/0116009	12/2001	Fraser et al.	N/A	N/A
2002/0143331	12/2001	Zucherman et al.	N/A	N/A
2002/0151977	12/2001	Paes et al.	N/A	N/A
2003/0040746	12/2002	Mitchell et al.	N/A	N/A
2003/0040753	12/2002	Daum et al.	N/A	N/A
2003/0074075	12/2002	Thomas et al.	N/A	N/A
2003/0083747	12/2002	Winterbottom et al.	N/A	N/A
2003/0105466	12/2002	Ralph et al.	N/A	N/A
2003/0135275	12/2002	Garcia et al.	N/A	N/A
2003/0149438	12/2002	Nichols et al.	N/A	N/A

2003/0153976	12/2002	Cauthen, III et al.	N/A	N/A
2003/0176921	12/2002	Lawson	N/A	N/A
2003/0220643	12/2002	Ferree	N/A	N/A
2003/0220650	12/2002	Major et al.	N/A	N/A
2003/0233098	12/2002	Markworth	N/A	N/A
2004/0087947	12/2003	Lim et al.	N/A	N/A
2004/0106997	12/2003	Lieberson	N/A	N/A
2004/0106999	12/2003	Mathews	N/A	N/A
2004/0148028	12/2003	Ferree et al.	N/A	N/A
2004/0167625	12/2003	Beyar et al.	N/A	N/A
2004/0220568	12/2003	Zucherman et al.	N/A	N/A
2004/0225295	12/2003	Zubok et al.	N/A	N/A
2004/0249378	12/2003	Saint Martin et al.	N/A	N/A
2004/0260305	12/2003	Gorensek et al.	N/A	N/A
2005/0021042	12/2004	Marnay et al.	N/A	N/A
2005/0049708	12/2004	Atkinson et al.	N/A	N/A
2005/0075634	12/2004	Zucherman et al.	N/A	N/A
2005/0090822	12/2004	DiPoto	N/A	N/A
2005/0101955	12/2004	Zucherman et al.	N/A	N/A
2005/0125066	12/2004	McAfee	N/A	N/A
2005/0143738	12/2004	Zucherman et al.	N/A	N/A
2005/0165398	12/2004	Reiley	N/A	N/A
2005/0192586	12/2004	Zucherman et al.	N/A	N/A
2005/0192671	12/2004	Bao et al.	N/A	N/A
2005/0209603	12/2004	Zucherman et al.	N/A	N/A
2005/0209698	12/2004	Gordon	N/A	N/A
2005/0216087	12/2004	Zucherman et al.	N/A	N/A
2005/0228383	12/2004	Zucherman et al.	N/A	N/A
2005/0228384	12/2004	Zucherman et al.	N/A	N/A
2005/0228426	12/2004	Campbell	N/A	N/A
2005/0245937	12/2004	Winslow	N/A	N/A
2005/0278036	12/2004	Leonard et al.	N/A	N/A
2006/0030860	12/2005	Peterman	N/A	N/A
2006/0036258	12/2005	Zucherman et al.	N/A	N/A
2006/0064107	12/2005	Bertagnoli et al.	N/A	N/A
2006/0064165	12/2005	Zucherman et al.	N/A	N/A
2006/0064166	12/2005	Zucherman et al.	N/A	N/A
2006/0074431	12/2005	Sutton et al.	N/A	N/A
2006/0084976	12/2005	Borgstrom et al.	N/A	N/A
2006/0084983	12/2005	Kim	N/A	N/A
2006/0084985	12/2005	Kim	N/A	N/A
2006/0084988	12/2005	Kim	N/A	N/A
2006/0084991	12/2005	Borgstrom et al.	N/A	N/A
2006/0085069	12/2005	Kim	N/A	N/A
2006/0085070	12/2005	Kim	N/A	N/A
2006/0085074	12/2005	Raiszadeh	N/A	N/A
2006/0089718	12/2005	Zucherman et al.	N/A	N/A
2006/0122458	12/2005	Bleich	N/A	N/A
2006/0122620	12/2005	Kim	N/A	N/A
2006/0149254	12/2005	Lauryssen et al.	N/A	N/A

2006/0149289	12/2005	Winslow et al.	N/A	N/A
2006/0167416	12/2005	Mathis et al.	N/A	N/A
2006/0195102	12/2005	Malandain	N/A	N/A
2006/0217811	12/2005	Lambrecht et al.	N/A	N/A
2006/0224159	12/2005	Anderson	N/A	N/A
2006/0235386	12/2005	Anderson	N/A	N/A
2006/0241597	12/2005	Mitchell et al.	N/A	N/A
2006/0241614	12/2005	Bruneau et al.	N/A	N/A
2006/0241757	12/2005	Anderson	N/A	N/A
2006/0247623	12/2005	Anderson et al.	N/A	N/A
2006/0247632	12/2005	Winslow et al.	N/A	N/A
2006/0247633	12/2005	Winslow et al.	N/A	N/A
2006/0247650	12/2005	Yerby et al.	N/A	N/A
2006/0247658	12/2005	Pond, Jr. et al.	N/A	N/A
2006/0247773	12/2005	Stamp	N/A	N/A
2006/0264938	12/2005	Zucherman et al.	N/A	N/A
2006/0264939	12/2005	Zucherman et al.	N/A	N/A
2006/0265066	12/2005	Zucherman et al.	N/A	N/A
2006/0265067	12/2005	Zucherman et al.	N/A	N/A
2006/0271044	12/2005	Petrini et al.	N/A	N/A
2006/0271049	12/2005	Zucherman et al.	N/A	N/A
2006/0271055	12/2005	Thramann	N/A	N/A
2006/0271061	12/2005	Beyar et al.	N/A	N/A
2006/0271194	12/2005	Zucherman et al.	N/A	N/A
2006/0276801	12/2005	Yerby et al.	N/A	N/A
2006/0276897	12/2005	Winslow et al.	N/A	N/A
2006/0282077	12/2005	Labrom et al.	N/A	N/A
2006/0282078	12/2005	Labrom et al.	N/A	N/A
2007/0016196	12/2006	Winslow et al.	N/A	N/A
2007/0032790	12/2006	Aschmann et al.	N/A	N/A
2007/0055237	12/2006	Edidin et al.	N/A	N/A
2007/0055246	12/2006	Zucherman et al.	N/A	N/A
2007/0073289	12/2006	Kwak et al.	N/A	N/A
2007/0073292	12/2006	Kohm et al.	N/A	N/A
2007/0100340	12/2006	Lange et al.	N/A	N/A
2007/0100366	12/2006	Dziedzic et al.	N/A	N/A
2007/0123863	12/2006	Winslow et al.	N/A	N/A
2007/0123904	12/2006	Stad et al.	N/A	N/A
2007/0161991	12/2006	Altarac et al.	N/A	N/A
2007/0161993	12/2006	Lowery et al.	N/A	N/A
2007/0173818	12/2006	Hestad et al.	N/A	N/A
2007/0173821	12/2006	Trieu	N/A	N/A
2007/0173822	12/2006	Bruneau et al.	N/A	N/A
2007/0173823	12/2006	Dewey et al.	N/A	N/A
2007/0173832	12/2006	Tebbe et al.	N/A	N/A
2007/0173939	12/2006	Kim et al.	N/A	N/A
2007/0179500	12/2006	Chin et al.	N/A	N/A
2007/0185490	12/2006	Implicito	N/A	N/A
2007/0191857	12/2006	Allard et al.	N/A	N/A
2007/0191948	12/2006	Amin et al.	N/A	N/A

2007/0191991	12/2006	Addink	N/A	N/A
2007/0198045	12/2006	Morton et al.	N/A	N/A
2007/0198091	12/2006	Boyer et al.	N/A	N/A
2007/0203493	12/2006	Zucherman et al.	N/A	N/A
2007/0203495	12/2006	Zucherman et al.	N/A	N/A
2007/0203496	12/2006	Zucherman et al.	N/A	N/A
2007/0203497	12/2006	Zucherman et al.	N/A	N/A
2007/0203501	12/2006	Zucherman et al.	N/A	N/A
2007/0208345	12/2006	Marnay et al.	N/A	N/A
2007/0208346	12/2006	Marnay et al.	N/A	N/A
2007/0208366	12/2006	Pellegrino et al.	N/A	N/A
2007/0210018	12/2006	Wallwiener et al.	N/A	N/A
2007/0225706	12/2006	Clark et al.	N/A	N/A
2007/0225724	12/2006	Edmond	N/A	N/A
2007/0225807	12/2006	Phan et al.	N/A	N/A
2007/0225814	12/2006	Atkinson et al.	N/A	N/A
2007/0233068	12/2006	Bruneau et al.	N/A	N/A
2007/0233074	12/2006	Anderson et al.	N/A	N/A
2007/0233076	12/2006	Trieu	N/A	N/A
2007/0233077	12/2006	Khalili	N/A	N/A
2007/0233081	12/2006	Pasquel et al.	N/A	N/A
2007/0233082	12/2006	Chin et al.	N/A	N/A
2007/0233083	12/2006	Abdou	N/A	N/A
2007/0233084	12/2006	Betz et al.	N/A	N/A
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2007/0233089	12/2006	DiPoto et al.	N/A	N/A
2007/0233096	12/2006	Garcia-Bengochea	N/A	N/A
2007/0233098	12/2006	Mastrorio et al.	N/A	N/A
2007/0233129	12/2006	Bertagnoli et al.	N/A	N/A
2007/0250060	12/2006	Anderson et al.	N/A	N/A
2007/0260245	12/2006	Malandain et al.	N/A	N/A
2007/0265623	12/2006	Malandain et al.	N/A	N/A
2007/0265624	12/2006	Zucherman et al.	N/A	N/A
2007/0265625	12/2006	Zucherman et al.	N/A	N/A
2007/0265626	12/2006	Seme	N/A	N/A
2007/0270822	12/2006	Heinz	N/A	N/A
2007/0270823	12/2006	Trieu et al.	N/A	N/A
2007/0270824	12/2006	Lim et al.	N/A	N/A
2007/0270826	12/2006	Trieu et al.	N/A	N/A
2007/0270827	12/2006	Lim et al.	N/A	N/A
2007/0270828	12/2006	Bruneau et al.	N/A	N/A
2007/0270829	12/2006	Carls et al.	N/A	N/A
2007/0270834	12/2006	Bruneau et al.	N/A	N/A
2007/0272259	12/2006	Allard et al.	N/A	N/A
2007/0276368	12/2006	Trieu et al.	N/A	N/A
2007/0276369	12/2006	Allard et al.	N/A	N/A
2007/0276370	12/2006	Altarac et al.	N/A	N/A
2007/0276372	12/2006	Malandain et al.	N/A	N/A
2007/0276373	12/2006	Malandain	N/A	N/A
2007/0276390	12/2006	Salsberg	N/A	N/A

2007/0276493	12/2006	Malandain et al.	N/A	N/A
2007/0276496	12/2006	Lange et al.	N/A	N/A
2007/0276497	12/2006	Anderson	N/A	N/A
2007/0276500	12/2006	Zucherman et al.	N/A	N/A
2008/0015700	12/2007	Zucherman et al.	N/A	N/A
2008/0021468	12/2007	Zucherman et al.	N/A	N/A
2008/0021560	12/2007	Zucherman et al.	N/A	N/A
2008/0021561	12/2007	Zucherman et al.	N/A	N/A
2008/0027545	12/2007	Zucherman et al.	N/A	N/A
2008/0027552	12/2007	Zucherman et al.	N/A	N/A
2008/0027553	12/2007	Zucherman et al.	N/A	N/A
2008/0033445	12/2007	Zucherman et al.	N/A	N/A
2008/0033553	12/2007	Zucherman et al.	N/A	N/A
2008/0033558	12/2007	Zucherman et al.	N/A	N/A
2008/0033559	12/2007	Zucherman et al.	N/A	N/A
2008/0039853	12/2007	Zucherman et al.	N/A	N/A
2008/0039858	12/2007	Zucherman et al.	N/A	N/A
2008/0039859	12/2007	Zucherman et al.	N/A	N/A
2008/0039945	12/2007	Zucherman et al.	N/A	N/A
2008/0039946	12/2007	Zucherman et al.	N/A	N/A
2008/0039947	12/2007	Zucherman et al.	N/A	N/A
2008/0045958	12/2007	Zucherman et al.	N/A	N/A
2008/0045959	12/2007	Zucherman et al.	N/A	N/A
2008/0046081	12/2007	Zucherman et al.	N/A	N/A
2008/0046085	12/2007	Zucherman et al.	N/A	N/A
2008/0046086	12/2007	Zucherman et al.	N/A	N/A
2008/0046087	12/2007	Zucherman et al.	N/A	N/A
2008/0046088	12/2007	Zucherman et al.	N/A	N/A
2008/0051785	12/2007	Zucherman et al.	N/A	N/A
2008/0051896	12/2007	Suddaby	N/A	N/A
2008/0051898	12/2007	Zucherman et al.	N/A	N/A
2008/0051899	12/2007	Zucherman et al.	N/A	N/A
2008/0051904	12/2007	Zucherman et al.	N/A	N/A
2008/0051905	12/2007	Zucherman et al.	N/A	N/A
2008/0058806	12/2007	Klyce et al.	N/A	N/A
2008/0058807	12/2007	Klyce et al.	N/A	N/A
2008/0058808	12/2007	Klyce et al.	N/A	N/A
2008/0058941	12/2007	Zucherman et al.	N/A	N/A
2008/0065086	12/2007	Zucherman et al.	N/A	N/A
2008/0065212	12/2007	Zucherman et al.	N/A	N/A
2008/0065213	12/2007	Zucherman et al.	N/A	N/A
2008/0065214	12/2007	Zucherman et al.	N/A	N/A
2008/0071280	12/2007	Winslow	N/A	N/A
2008/0071378	12/2007	Zucherman et al.	N/A	N/A
2008/0071380	12/2007	Sweeney	N/A	N/A
2008/0086212	12/2007	Zucherman et al.	N/A	N/A
2008/0108990	12/2007	Mitchell et al.	N/A	N/A
2008/0114455	12/2007	Lange et al.	N/A	N/A
2008/0132952	12/2007	Malandain et al.	N/A	N/A
2008/0167655	12/2007	Wang et al.	N/A	N/A

2008/0167656	12/2007	Zucherman et al.	N/A	N/A
2008/0167657	12/2007	Greenhalgh	N/A	N/A
2008/0172057	12/2007	Zucherman et al.	N/A	N/A
2008/0177271	12/2007	Yeh	N/A	N/A
2008/0177272	12/2007	Zucherman et al.	N/A	N/A
2008/0177306	12/2007	Lamborne et al.	N/A	N/A
2008/0177312	12/2007	Perez-Cruet et al.	N/A	N/A
2008/0183210	12/2007	Zucherman et al.	N/A	N/A
2008/0188895	12/2007	Cragg et al.	N/A	N/A
2008/0195152	12/2007	Altarac et al.	N/A	N/A
2008/0208344	12/2007	Kilpela et al.	N/A	N/A
2008/0215058	12/2007	Zucherman et al.	N/A	N/A
2008/0221692	12/2007	Zucherman et al.	N/A	N/A
2008/0228225	12/2007	Trautwein et al.	N/A	N/A
2008/0234708	12/2007	Houser et al.	N/A	N/A
2008/0234824	12/2007	Youssef et al.	N/A	N/A
2008/0287997	12/2007	Altarac et al.	N/A	N/A
2008/0288075	12/2007	Zucherman et al.	N/A	N/A
2008/0319550	12/2007	Altarac et al.	N/A	N/A
2009/0012528	12/2008	Aschmann et al.	N/A	N/A
2009/0118833	12/2008	Hudgins et al.	N/A	N/A
2009/0125030	12/2008	Tebbe et al.	N/A	N/A
2009/0125036	12/2008	Bleich	N/A	N/A
2009/0138046	12/2008	Altarac et al.	N/A	N/A
2009/0138055	12/2008	Altarac et al.	N/A	N/A
2009/0222043	12/2008	Altarac et al.	N/A	N/A
2009/0248079	12/2008	Kwak et al.	N/A	N/A
2009/0265007	12/2008	Colleran	606/90	A61F 2/4611
2009/0292315	12/2008	Trieu	N/A	N/A
2009/0292316	12/2008	Hess	N/A	N/A
2010/0042217	12/2009	Zucherman et al.	N/A	N/A
2010/0082108	12/2009	Zucherman et al.	N/A	N/A
2010/0114100	12/2009	Mehdizade	N/A	N/A
2010/0131009	12/2009	Roebling et al.	N/A	N/A
2010/0152775	12/2009	Seifert	623/17.11	A61B 17/3468
2010/0160947	12/2009	Akyuz et al.	N/A	N/A
2010/0228092	12/2009	Ortiz et al.	N/A	N/A
2010/0234889	12/2009	Hess	N/A	N/A
2010/0262243	12/2009	Zucherman et al.	N/A	N/A
2010/0280551	12/2009	Pool	N/A	N/A
2010/0305611	12/2009	Zucherman et al.	N/A	N/A
2011/0172710	12/2010	Thommen et al.	N/A	N/A
2011/0245833	12/2010	Anderson	N/A	N/A
2011/0313457	12/2010	Reglos et al.	N/A	N/A
2012/0078301	12/2011	Hess	N/A	N/A
2012/0158063	12/2011	Altarac et al.	N/A	N/A
2012/0226315	12/2011	Altarac et al.	N/A	N/A

2012/0232552	12/2011	Morgenstern Lopez et al.	N/A	N/A
2012/0303039	12/2011	Chin et al.	N/A	N/A
2012/0330359	12/2011	Kim	N/A	N/A
2013/0012998	12/2012	Altarac et al.	N/A	N/A
2013/0072985	12/2012	Kim	N/A	N/A
2013/0165974	12/2012	Kim	N/A	N/A
2013/0165975	12/2012	Tebbe et al.	N/A	N/A
2013/0172932	12/2012	Altarac et al.	N/A	N/A
2013/0172933	12/2012	Altarac et al.	N/A	N/A
2013/0289399	12/2012	Choi et al.	N/A	N/A
2013/0289622	12/2012	Kim	N/A	N/A
2014/0081332	12/2013	Altarac et al.	N/A	N/A
2014/0214082	12/2013	Reglos et al.	N/A	N/A
2014/0358186	12/2013	Frock	606/86A	A61B 17/8891
2015/0150598	12/2014	Tebbe et al.	N/A	N/A
2015/0150604	12/2014	Kim	N/A	N/A
2015/0374415	12/2014	Kim	N/A	N/A
2016/0030092	12/2015	Altarac et al.	N/A	N/A
2016/0066963	12/2015	Kim	N/A	N/A
2016/0242822	12/2015	Altarac et al.	N/A	N/A
2016/0317193	12/2015	Kim	N/A	N/A
2017/0071588	12/2016	Choi et al.	N/A	N/A
2017/0128110	12/2016	Altarac et al.	N/A	N/A
2017/0156763	12/2016	Altarac et al.	N/A	N/A
2017/0245883	12/2016	Tebbe et al.	N/A	N/A
2017/0258501	12/2016	Altarac et al.	N/A	N/A
2017/0273722	12/2016	Altarac et al.	N/A	N/A
2017/0296238	12/2016	Snell et al.	N/A	N/A
2017/0348028	12/2016	Calvosa et al.	N/A	N/A
2018/0028130	12/2017	Choi	N/A	N/A
2018/0193064	12/2017	Kim	N/A	N/A
2018/0228519	12/2017	Altarac et al.	N/A	N/A
2019/0069933	12/2018	Altarac et al.	N/A	N/A
2019/0090912	12/2018	Altarac et al.	N/A	N/A
2019/0090913	12/2018	Altarac et al.	N/A	N/A
2019/0105082	12/2018	Altarac et al.	N/A	N/A
2019/0105083	12/2018	Kim	N/A	N/A
2019/0201057	12/2018	Altarac et al.	N/A	N/A
2021/0100592	12/2020	Seifert et al.	N/A	N/A
2022/0054280	12/2021	Frock	N/A	A61B 17/7065
2022/0061894	12/2021	Altarac et al.	N/A	N/A
2023/0240726	12/2022	Linares	N/A	N/A
2023/0255786	12/2022	Lin	623/17.16	A61F 2/4405
2024/0277384	12/2023	Malinowski	N/A	A61B 17/7065

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
268461	12/1926	CA	N/A
2794456	12/2005	CN	N/A
101897603	12/2009	CN	N/A
322334	12/1988	EP	N/A
0767636	12/1998	EP	N/A
0768843	12/1998	EP	N/A
1138268	12/2000	EP	N/A
1056408	12/2002	EP	N/A
1343424	12/2003	EP	N/A
1454589	12/2003	EP	N/A
1330987	12/2004	EP	N/A
1299042	12/2005	EP	N/A
1578314	12/2006	EP	N/A
1675535	12/2006	EP	N/A
0959792	12/2006	EP	N/A
1027004	12/2006	EP	N/A
1030615	12/2006	EP	N/A
1570793	12/2007	EP	N/A
1148850	12/2008	EP	N/A
1861046	12/2011	EP	N/A
2681525	12/1992	FR	N/A
2717675	12/1995	FR	N/A
2722980	12/1995	FR	N/A
2816197	12/2001	FR	N/A
988281	12/1982	SU	N/A
WO9404088	12/1993	WO	N/A
WO9426192	12/1993	WO	N/A
WO9525485	12/1994	WO	N/A
WO9531158	12/1994	WO	N/A
WO9600049	12/1995	WO	N/A
WO9829047	12/1997	WO	N/A
WO9921500	12/1998	WO	N/A
WO9921501	12/1998	WO	N/A
WO9942051	12/1998	WO	N/A
WO0013619	12/1999	WO	N/A
WO0044319	12/1999	WO	N/A
WO0044321	12/1999	WO	N/A
WO0128442	12/2000	WO	N/A
WO0191657	12/2000	WO	N/A
WO0191658	12/2000	WO	N/A
WO0203882	12/2001	WO	N/A
WO0207623	12/2001	WO	N/A
WO0207624	12/2001	WO	N/A
WO02051326	12/2001	WO	N/A
WO02067793	12/2001	WO	N/A
WO02071960	12/2001	WO	N/A

WO02076336	12/2001	WO	N/A
WO03007791	12/2002	WO	N/A
WO03007829	12/2002	WO	N/A
WO03008016	12/2002	WO	N/A
WO03015646	12/2002	WO	N/A
WO03024298	12/2002	WO	N/A
WO03045262	12/2002	WO	N/A
WO03099147	12/2002	WO	N/A
WO03101350	12/2002	WO	N/A
WO04073533	12/2003	WO	N/A
WO04110300	12/2003	WO	N/A
WO05009300	12/2004	WO	N/A
WO05013839	12/2004	WO	N/A
WO05025461	12/2004	WO	N/A
WO05041799	12/2004	WO	N/A
WO05044152	12/2004	WO	N/A
WO05055868	12/2004	WO	N/A
WO05079672	12/2004	WO	N/A
WO2005086776	12/2004	WO	N/A
WO05115261	12/2004	WO	N/A
WO06033659	12/2005	WO	N/A
WO06034423	12/2005	WO	N/A
WO06039243	12/2005	WO	N/A
WO06039260	12/2005	WO	N/A
WO06045094	12/2005	WO	N/A
WO06063047	12/2005	WO	N/A
WO06065774	12/2005	WO	N/A
WO2006064356	12/2005	WO	N/A
WO2006089085	12/2005	WO	N/A
WO06102269	12/2005	WO	N/A
WO06102428	12/2005	WO	N/A
WO06102485	12/2005	WO	N/A
WO06107539	12/2005	WO	N/A
WO06110462	12/2005	WO	N/A
WO06110464	12/2005	WO	N/A
WO06110767	12/2005	WO	N/A
WO06113080	12/2005	WO	N/A
WO06113406	12/2005	WO	N/A
WO06113814	12/2005	WO	N/A
WO2006106246	12/2005	WO	N/A
WO06118945	12/2005	WO	N/A
WO06119235	12/2005	WO	N/A
WO06119236	12/2005	WO	N/A
WO06135511	12/2005	WO	N/A
WO2007010140	12/2006	WO	N/A
WO07015028	12/2006	WO	N/A
WO07035120	12/2006	WO	N/A
WO07075375	12/2006	WO	N/A
WO07075788	12/2006	WO	N/A
WO07075791	12/2006	WO	N/A

WO07089605	12/2006	WO	N/A
WO07089905	12/2006	WO	N/A
WO07089975	12/2006	WO	N/A
WO07097735	12/2006	WO	N/A
WO07109402	12/2006	WO	N/A
WO07110604	12/2006	WO	N/A
WO07111795	12/2006	WO	N/A
WO07111979	12/2006	WO	N/A
WO07111999	12/2006	WO	N/A
WO07117882	12/2006	WO	N/A
WO07121070	12/2006	WO	N/A
WO07127550	12/2006	WO	N/A
WO07127588	12/2006	WO	N/A
WO07127677	12/2006	WO	N/A
WO07127689	12/2006	WO	N/A
WO07127694	12/2006	WO	N/A
WO07127734	12/2006	WO	N/A
WO07127736	12/2006	WO	N/A
WO07131165	12/2006	WO	N/A
WO07134113	12/2006	WO	N/A
WO2008009049	12/2007	WO	N/A
WO08048645	12/2007	WO	N/A
WO2008057506	12/2007	WO	N/A
WO2008130564	12/2007	WO	N/A
WO2009014728	12/2008	WO	N/A
WO2009033093	12/2008	WO	N/A
WO2009083276	12/2008	WO	N/A
WO2009083583	12/2008	WO	N/A
WO2009086010	12/2008	WO	N/A
WO2009091922	12/2008	WO	N/A
WO2009094463	12/2008	WO	N/A
WO2009114479	12/2008	WO	N/A
WO2011084477	12/2010	WO	N/A
WO2015171814	12/2014	WO	N/A

OTHER PUBLICATIONS

ASNR Neuroradiology Patient Information website, Brain and Spine Imaging: A Patient's Guide to Neuroradiology; Myelography; http://www.asnr.org/patientinfo/procedures/myelography.shtml#sthash.sXIDOxWq.dpbs, Copyright 2012-2013. cited by applicant

Choi, Gun et al., “Percutaneous Endoscopic Interlaminar Disectomy for Intracanalicular Disc Herniations at L5-S1 Using a Rigid Working Channel Endoscope,” Operative Neurosurg., 58: pp. 59-68 (2006). cited by applicant

Fast, Avital et al., “Surgical Treatment of Lumbar Spinal Stenosis in the Elderly,” Arch Phys. Med Rehabil., Mar. 1985, pp. 149-151, vol. 66. cited by applicant

Lee, Seungcheol et al., “New Surgical Techniques of Percutaneous Endoscopic Lumbar Disectomy for Migrated Disc Herniation,” Joint Dis. Rel. Surg., 16(2); pp. 102-110 (2005). cited by applicant

Lee, Seungcheol et al., “Percutaneous Endoscopic Interlaminar Disectomy for L5-S1 Disc Herniation: Axillary Approach and Preliminary Results,” J. of Korean Neurosurg. Soc., 40: pp. 79-83 (2006). cited by applicant

McCulloch, John A., Young, Paul H., “Essentials of Spinal Microsurgery,” 1998, pp. 453-485. Lippincott-Raven Publishers, Philadelphia, PA (37 pages total). cited by applicant
Minns, R.J., et al., “Preliminary Design and Experimental Studies of a Noval Soft Implant for Correcting Sagittal Plane Instability in the Lumbar Spine,” (1997) Spine, 22(16): 1819-1825. cited by applicant
Palmer, Sylvain et al., “Bilateral decompressive surgery in lumbar spinal stenosis associated with spondylolisthesis: unilateral approach and use of a microscope and tubular retractor system,” Neurosurgery Focus, Jul. 2002, pp. 1-6, vol. 13. cited by applicant
Swan, Colby, “Point of View: Preliminary Design and Experimental Studies of a Novel Soft Implant for Correcting Sogittal Plane Instability in the Lumbar Spine,” Spine, 1997, 22(16), 1826-1827. cited by applicant
Tredway, Trent L. et al., “Minimally Invasive Transforaminal Lumbar Interbody Fusion (MI-TLIF) and Lateral Mass Fusion with the MetRx System,” (14 pages total), 2005. cited by applicant
Vaccaro, Alexander J. et al., MasterCases Spine Surgery, 2001, pp. 100-107. Thieme Medical Publishers, Inc., NY. (10 pages total). cited by applicant
Vertos mild Devices Kit—PRT-00430-C—Instructions for Use (13 pages total); see http://vertosmed.com/docs/mild1FU_PRT-00430-C.pdf., 2012. cited by applicant

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Primary Examiner: Robert; Eduardo C

Attorney, Agent or Firm: Branch Partners PLLC

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application Ser. No. 63/452,249, filed Mar. 15, 2023, which is incorporated herein by reference.

FIELD
(1) The present invention is directed to the area of interspinous spacers for deployment between adjacent spinous processes. The present invention is also directed to systems and methods for utilizing the interspinous spacer.
BACKGROUND
(2) With spinal stenosis, the spinal canal narrows and pinches the spinal cord and nerves, causing pain in the back and legs. Typically, with age, a person's ligaments may thicken, intervertebral discs may deteriorate, or facet joints may break down. The conditions can contribute to the narrowing of the spinal canal. Injury, heredity, arthritis, changes in blood flow, and other causes may also contribute to spinal stenosis.
(3) Various treatments of the spine have been proposed or used including medications, surgical techniques, and implantable devices that alleviate and reduce pain associated with the back. In one surgical technique, a spacer is implanted between adjacent spinous processes of a patient's spine. The implanted spacer opens the spinal canal, maintains the desired distance between vertebral body segments, and, as a result, avoids or reduces impingement of nerves and relieves pain. For suitable candidates, an implantable interspinous spacer may provide significant benefits in terms of pain relief.
BRIEF SUMMARY
(4) One aspect is an interspinous spacer that includes a body having a distal portion, a proximal portion, a proximal surface, a channel extending longitudinally from the proximal surface, and at least one slot extending longitudinally along the distal portion; an arm actuator defining a threaded

channel extending longitudinally, wherein the arm actuator is configured to fit within the body; an actuator screw including a shaft having a proximal end and a distal portion, wherein the actuator screw further includes a head coupled to the proximal end of the shaft, wherein the distal portion of the shaft of the actuator screw is threaded and the actuator screw is at least partially disposed in the channel of the body and the threaded channel of the arm actuator, wherein, as the actuator screw is rotated using a driver tool, the arm actuator moves longitudinally relative to the body; a first pin, wherein the first pin is arranged to move along the at least one slot of the body; a second pin; and a first arm and a second arm, wherein each of the first and second arms includes a bridge, at least two receiving extensions extending from the bridge in a first direction and configured for receiving a portion of a vertebra therebetween, and a coupling extension extending from the bridge in a second direction, wherein each of the coupling extensions defines a pin opening and a curved track, wherein the first and second arms are coupled to the distal portion of the body by the second pin extending through the curved tracks of the coupling extensions and further coupled to the distal portion of the body and the actuator arm by the first pin extending through the pin openings of the coupling extensions, wherein the first and second arms are configured to rotate among different deployment positions according to the curved track in response to longitudinal movement of the actuator arm as the actuator screw is rotated.

(5) In at least some aspects, the actuator screw further includes a disc disposed along the shaft distal to, and separated from, the head, wherein the shaft has an outer diameter that is smaller than outer diameters of the disc and the head. In at least some aspects, the disc includes a plurality of teeth arranged around a perimeter of the disc. In at least some aspects, the interspinous spacer further includes at least one locking inset positioned within the channel of the body for engagement by the disc of the actuator screw, each of the at least one locking inset including at least one tooth for interaction with the teeth of the disc to limit rotation of the actuator screw absent the driver tool. In at least some aspects, the interspinous spacer further includes a locking ring configured for engagement with the actuator screw between the head and the disc to limit movement of the actuator screw proximally or distally within the channel of the body, wherein the body defines a bounded groove within the channel to receive the locking ring, wherein the locking ring is a partial or full ring.

(6) In at least some aspects, the interspinous spacer further includes each of the first arm and the second arm includes at least two of the coupling extensions. In at least some aspects, the interspinous spacer further includes the coupling extensions of the first arm interleave with the coupling extensions of the second arm.

(7) In at least some aspects, the interspinous spacer further includes the body includes opposing undercut notches configured for receiving a clamp of a spacer insertion instrument. In at least some aspects, the interspinous spacer further includes the actuator screw further includes a shaped cavity formed in the head, wherein the shaped cavity is configured for receiving a bit of the driver tool that has a shape complementary to the shaped cavity.

(8) Another aspect is an interspinous spacer that includes a body having a distal portion, a proximal portion, a proximal surface, and a channel extending longitudinally from the proximal surface; an arm actuator defining a threaded channel extending longitudinally, wherein the arm actuator is configured to fit within the body; an actuator screw including a shaft having a proximal end and a distal portion, a head coupled to the proximal end of the shaft, and a disc disposed along the shaft distal to, and separated from, the head, wherein the distal portion of the shaft of the actuator screw is threaded and the actuator screw is at least partially disposed in the channel of the body and the threaded channel of the arm actuator, wherein the disc includes a plurality of teeth arranged around a perimeter of the disc, wherein, as the actuator screw is rotated using a driver tool, the arm actuator moves longitudinally relative to the body; at least one locking inset positioned within the channel of the body for engagement by the disc of the actuator screw, each of the at least one locking inset including at least one tooth for interaction with the teeth of the disc to limit rotation of

the actuator screw absent the driver tool; and a first arm and a second arm, wherein each of the first and second arms includes a bridge, at least two receiving extensions extending from the bridge in a first direction and configured for receiving a portion of a vertebra therebetween, and a coupling extension extending from the bridge in a second direction, wherein each of the coupling extensions is coupled to the distal portion of the body and the actuator arm.
(9) In at least some aspects, the interspinous spacer further includes a locking ring configured for engagement with the actuator screw between the head and the disc to limit movement of the actuator screw proximally or distally within the channel of the body, wherein the body defines a bounded groove within the channel to receive the locking ring, wherein the locking ring is a partial or full ring. In at least some aspects, each of the first arm and the second arm includes at least two of the coupling extensions. In at least some aspects, the coupling extensions of the first arm interleave with the coupling extensions of the second arm.
(10) In at least some aspects, the body further includes at least one slot extending longitudinally along the distal portion of the body, the interspinous spacer further including a first pin, wherein the first pin is arranged to move along the at least one slot of the body, wherein each of the coupling extensions defines a pin opening, wherein the first and second arms are coupled to the distal portion of the body and the actuator arm by the first pin extending through the pin openings of the coupling extension. In at least some aspects, the interspinous spacer further includes a second pin, wherein each of the coupling extensions further defines a curved track, wherein the first and second arms are coupled to the distal portion of the body by the second pin through the curved tracks of the coupling extensions, wherein the first and second arms are configured to rotate relative to the body according to the curved track in response to longitudinal movement of the actuator arm as the actuator screw is rotated.
(11) In at least some aspects, the at least one locking inset includes two locking insets disposed opposite each other. In at least some aspects, the body includes opposing undercut notches configured for receiving a clamp of a spacer insertion instrument. In at least some aspects, the actuator screw further includes a shaped cavity formed in the head, wherein the shaped cavity is configured for receiving a bit of the driver tool that has a shape complementary to the shaped cavity.
(12) Yet another aspect is a kit that includes any of the interspinous spacers described above; a spacer insertion instrument configured to releasably grip the interspinous spacer for implantation into a patient; and the driver tool having a spacer engaging bit configured to engage the actuator screw of the interspinous spacer and rotate the actuator screw by rotation of the driver tool.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) Non-limiting and non-exhaustive embodiments of the present invention are described with reference to the following drawings. In the drawings, like reference numerals refer to like parts throughout the various figures unless otherwise specified.
(2) For a better understanding of the present invention, reference will be made to the following Detailed Description, which is to be read in association with the accompanying drawings, wherein:
(3) FIG. **1**A is a schematic perspective view of one embodiment of an interspinous spacer in a first deployed position;
(4) FIG. **1**B is a schematic perspective view of the interspinous spacer of FIG. **1**A in a second deployed position;
(5) FIG. **1**C is a schematic perspective exploded view of the interspinous spacer of FIG. **1**A;
(6) FIG. **2** is schematic perspective side view of an actuator screw, locking inserts, and locking ring of the interspinous spacer of FIG. **1**A;

(7) FIG. **3** is schematic perspective side view of arms and a pin of the interspinous spacer of FIG. **1**A;
(8) FIG. **4** is schematic side view of the interspinous spacer of FIG. **1**A illustrating different separation distances, represented by vertical lines, for the arms;
(9) FIG. **5** is a perspective view of one embodiment of a spacer insertion instrument; and
(10) FIG. **6** is a perspective view of one embodiment of a driver tool.

DETAILED DESCRIPTION

(11) The present invention is directed to the area of interspinous spacers for deployment between adjacent spinous processes. The present invention is also directed to systems and methods for utilizing the interspinous spacer.

(12) Examples of interspinous spacers are found in U.S. Pat. Nos. 8,123,782; 8,128,662; 8,273,108; 8,277,488; 8,292,922; 8,425,559; 8,613,747; 8,864,828; 9,119,680; 9,155,572; 9,161,783; 9,393,055; 9,532,812; 9,572,603; 9,861,398; 9,956,011; 10,080,587; 10,166,047; 10,610,267; 10,653,456; 10,835,295; 10,835,297; 11,013,539; and 11,229,461, all of which are incorporated herein by reference. Unless indicated otherwise, the features and methods described in these references can be applied to the interspinous spacers described herein.

(13) Conventional interspinous spacers typically have a fixed distance between the two arms when deployed. Conventionally, interspinous spacers of different sizes are available and the clinician selects which size is to be used for a particular surgery based on the size and arrangement of the vertebrae.

(14) In addition, in at least some conventional interspinous spacers, a spindle arrangement is provided for engagement by a tool and rotation using the tool to cause the arms of the spacer to rotate for engagement with the vertebrae (for example the spinous processes of the adjacent vertebrae). The spindle arrangement is welded to the body of the interspinous spacer.

(15) As described herein, a single interspinous spacer can have a range of deployment positions (for example, provide for a range of distances between the two arms when deployed). This allows the interspinous spacer to fit a range of different spacings between adjacent vertebrae. Additionally or alternatively, an interspinous spacer can utilize an actuator screw instead of a spindle arrangement, as described herein.

(16) FIGS. **1**A, **1**B, **1**C, **2**, **3**, and **4** illustrate one embodiment of an interspinous spacer **100** that includes a body **102**, a first (or superior) arm **104**, a second (or inferior) arm **106**, an actuator screw **108**, two locking inserts **112**, a locking ring **113**, a first pin **114***a*, a second pin **114***b*, and an arm actuator **115**. There is no weld between the body **102** and the actuator screw **108**.

(17) In FIG. **1**A, the first and second arms **104**, **106** of the spacer **100** are in a first deployed position with the first and second arms **104**, **106** separated by a first distance (for example, 8 mm). In FIG. **1**B, the first and second arms **104**, **106** of the spacer **100** are in a second deployed position with the first and second arms **104**, **106** separated by a second distance (for example, 16 mm). In this embodiment, the first and second arms **104**, **106** has a range of deployment positions from the first deployed position to the second deployed position. The first and second arms **104**, **106** can be separated by any distance in the range from the first distance to the second distance (for example, any distance from 8 to 16 mm). This allows the spacer **100** to fit a range of different spacings between adjacent vertebrae.

(18) The first arm **104** includes two receiving extensions **104***a*, **104***b* coupled by a bridge **105** from which an attachment portion **142** extends. The second arm **106** includes two receiving extensions **106***a*, **106***b* coupled by a bridge **107** from which the attachment portion **142** extends. In each deployment position, the pairs of receiving extensions **104***a*, **104***b*, **106***a*, **106***b* extend away from the body **102** of the spacer **100** with the extensions of each pair disposed on opposing sides of one of the adjacent vertebrae (for example, the spinous process of the adjacent vertebra), as illustrated in FIGS. **1**A and **1**B. The first and second arms **104**, **106** of the spacer **100** are not necessarily perpendicular to the longitudinal axis of the body **102**. Instead, the angle of the first and second

arms **104**, **106** of the spacer **100** relative to the longitudinal axis of the body **102** depends on the selected deployed position which can range from the first deployed position of FIG. **1**A to the second deployed position of FIG. **1**B. In at least some embodiments, the shape of the bridges **105**, **107** is selected to provide suitable engagement of the adjacent vertebrae for the range of selectable deployed positions.

(19) In at least some embodiments, the length of the bridge **105** of the first arm **104** is approximately 7 to 10 millimeters and the length of the bridge **107** of the second arm **106** is approximately 5 to 8 millimeters. In at least some embodiments, the tip-to-tip distance of the extensions **104***a*, **104***b* is approximately 8 to 12 millimeters and the tip-to-tip distance of the extensions **106***a*, **106***b* is approximately 8 to 12 millimeters. In at least some embodiments, the first arm **104** forms a larger space for receiving the superior vertebra (for example, the superior spinous process) than the space formed by the second arm **106** for receiving the inferior vertebra (for example, the inferior spinous process) as vertebrae and spinous processes are naturally narrower on top and wider on the bottom. In at least some embodiments, where there is a difference in size between the first and second arms **104**, **106**, the spacer **100** may include a marking or other indication so that a clinician can individually identify the first and second arms **104**, **106** for correct implantation orientation within the patient.

(20) In at least some other embodiments, the first and second arms **104**, **106** form a same-sized space for receiving the vertebrae. In at least some embodiments, the bridges **105**, **107** of the first and second arms **104**, **106** have a same length.

(21) The body **102** includes a distal portion **102***a*, a proximal portion **102***b*, a proximal surface **102***c*, and an opening **102***d* in the proximal surface for the actuator screw **108**. The body **102** defines a channel **116** that extends distally from the opening **102***d* through at least a portion of the body **102**, as illustrated in FIG. **1**C. In at least some embodiments, the body **102** includes undercut notches **103** formed on opposite sides of the proximal portion **102***b* of the body. In at least some embodiments, the notches **103** are configured for attachment of clamps **795** of a spacer insertion instrument **790** (FIG. **5**).

(22) The body **102** includes opposing slots **160** (or at least one slot) for receiving a first pin **114***a* and travel of the first pin along the slots as the first and second arms **104**, **106** are deployed or retracted. The body **102** also includes opposing pin holes **141**, distal of the opposing slots **160**, for receiving a second pin **114***b*.

(23) The actuator screw **108** includes a head **117**, a shaft **118**, and a disc **120** disposed along the shaft and having teeth **122** arranged around the perimeter of the disc, as illustrated in FIG. **2**. The disc **120** has a larger outer diameter than the shaft **118** and is positioned distal to the head **117** with a gap **168** between the disc and the head. At least a portion **121** of the shaft **118** distal to the disc is threaded. The actuator screw **108** can be made from a single piece of material or may contain two or more components that are attached together. The head **117** of the actuator screw **108** includes a shaped cavity **119** to receive a driver tool **880** (FIG. **6**) with a complementary-shaped engaging bit **884**. Engagement of the actuator screw **108** by the driver tool allows a user to rotate the actuator screw to further separate (or, in at least some embodiments, retract) the first and second arms **104**, **106**.

(24) A locking ring **113** fits on the actuator screw **108** in the gap **168** between the head **117** and the disc **120**. As the actuator screw **108** is inserted into the channel **116** of the body **102**, the locking ring **113** fits within a bounded groove **133** in the interior wall of the body. The locking ring **113** resists movement of the actuator screw **108** up or down (e.g., distally or proximally) within the body **102**. The locking ring **113** can be a full ring or a partial ring (as illustrated in FIG. **1**C).

(25) Locking insets **112** fit within opposing indents **134** located below the bounded groove **133** in the interior wall of the body **102** so that the locking insets **112** are exposed within the body. Each locking inset **112** includes a body **138** and at least one tooth **140** (FIG. **2**) extending from the body. The at least one tooth **140** of the locking inset **112** is arranged to engage the teeth **122** of the disc

120 of the actuator screw **108** when the actuator screw is disposed within the body **102**. The at least one tooth **140** of the locking insets **112** and the teeth **122** of the disc **120** of the actuator screw **108** are arranged to resist rotation of the actuator screw except by use of a tool **880** (FIG. **6**) that engages the actuator screw **108**. In at least some embodiments, the shape and size of the at least one tooth **140** of the locking insets **112** and the teeth **122** of the disc **120** of the actuator screw **108** are selected to resist rotation of the actuator screw when the first and second arms **104**, **106** are separated at a selected deployment position and force is applied to the first and second arms **104**, **106** such as, for example, during the patient's movement and bending. In at least some embodiments, the shape and size of the at least one tooth **140** of the locking insets **112** and the teeth **122** of the disc **120** of the actuator screw **108** are selected to generate a clicking sound as the actuator screw **108** is rotated using a tool **880** (FIG. **6**).

(26) The arm actuator **115** includes a threaded channel **154** into which the threaded portion **121** of the shaft **118** of the actuator screw **108** extends. The threads and the size of the threaded channel **154** of the arm actuator **115** and the threaded shaft **118** of the actuator screw **108** are complementary so that the actuator screw **108** fits within the threaded channel **154** and moves distally or proximally, along a path defined by the threads, as the actuator screw **108** is rotated. The arm actuator **115** further includes two opposing actuator extensions **156** that each define a pin opening **158** for receiving the first pin **114***a*.

(27) Each of the first and second arms **104**, **106** includes at least one coupling extension **162** extending from the bridge **105**, **107**. Each coupling extension **162** defines an opening **164** for receiving the first pin **114***a*, as illustrated in FIG. **3**, and a curved track **166** for receiving the second pin **114***b* and allowing the second pin to move along the curved track in response to rotation of the actuator screw **108**. In the illustrated embodiment of FIGS. **1**A, **1**B, **1**C, and **3**, each of the first and second arms **104**, **106** includes two coupling extensions **162** that, when the spacer **100** is assembled, interleave with each other as illustrated in FIG. **3**. When the spacer **100** is assembled, the first pin **114***a* passes through the opposing slots **160** of the body **102**, the pin openings **158** of the arm actuator **115**, and the openings **164** of the coupling extensions **162** of the first and second arms **104**, **106**. The second pin **115***b* passes through the opposing pin holes **141** of the body **102** and the curved tracks **166** of the coupling extensions **162** of the first and second arms **104**, **106**.

(28) As the actuator screw **108** is rotated in a first direction, the arm actuator **115** moves distally. The first pin **114***a* is carried distally by the arm actuator **115** pushing the portions of the first and second arms **104**, **106** adjacent to the first pin **114***a* distally. This causes the first and second arms **104**, **106** to rotate about the second pin **114***b* according to the path of the curved tracks **166** of the first and second arms **104**, **106** resulting in the first and second arms separating from each other, as illustrated by comparing FIGS. **1**A and **1**B.

(29) Rotating the actuator screw **108** in a second direction, opposite the first direction, reverses the movement of the arm actuator **115**, pin **114***a*, and first and second arms **104**, **106**. The ends of the opposing slots **160** of the body **102** limit movement of the first pin **114***a* and, thereby, limit the range of separation of the first and second arms **104**, **106**.

(30) In the first deployed position of FIG. **1**A, the first pin **114***a* is at the most proximal position along opposing slots **160** in the body **102**. In the first deployed position of FIG. **1**B, the first pin **114***a* is at the most distal position along the opposing slots **160** in the body **102**. FIG. **4** illustrates examples of different separation distances **170** (representing different deployed positions) between the first and second arms **104**, **106** for one embodiment of the spacer **100**. Examples of separation distances are illustrated in FIG. **4** as d.sub.1, d.sub.2, d.sub.3, d.sub.4, and d.sub.5 (for example, 8, 10, 12, 14, or 16 mm, respectively). In at least some embodiments, any distance between the largest and smallest separation distance can be achieved. In at least some embodiments, the selectable distances may be defined in part by the teeth **122** on the disc **120** of the actuator screw **118**, as well as the length of the opposing slots **160** of the body **102**.

(31) U.S. Pat. Nos. 8,123,782; 8,128,662; 8,273,108; 8,277,488; 8,292,922; 8,425,559; 8,613,747;

8,864,828; 8,945,183; 9,119,680; 9,155,572; 9,161,783; 9,393,055; 9,532,812; 9,572,603; 9,861,398; 9,956,011; 10,080,587; 10,166,047; 10,610,267; 10,653,456; 10,835,295; 10,835,297; 11,013,539; and 11,229,461, all of which are incorporated herein by reference, illustrate a variety of tools for insertion and deployment of a spacer between adjacent spinous processes. These tools can be used or modified for insertion and deployment of the spacer **100** described above.

(32) As an example, FIGS. **5** and **6** illustrate a spacer insertion instrument **790** and a driver tool **880**, respectively. The spacer insertion instrument **790** includes a cannula **791** connected to a handle **792**. The spacer insertion instrument **790** defines a central passageway **793** through the handle **792** and cannula **791**. The driver tool **880** is removably insertable into the central passageway **793**.

(33) The cannula **791** includes clamps (for example, prongs) **795** to releasably clamp to the body **102** of the spacer **100** (for example, to the undercut notches **103** formed on opposite sides of the body **102**) for delivery of the spacer into the patient using the spacer insertion instrument **790**. In at least some embodiments, the clamps **795** include extensions **796** that extend inwardly toward each other to form hooks. In at least some embodiments, the extensions **796** can engage the undercut notches **103** (FIG. **1**C) formed on opposite sides of the body **102** of the spacer **100** to grip the spacer.

(34) The cannula **791** also includes an inner shaft **797** (to which the clamps **795** are attached), an outer shaft **794**, and a control **798**. In at least some embodiments, the inner shaft **797** is connected to the handle **792** and the outer shaft **794** is passed over the inner shaft **797**.

(35) The outer shaft **794** translates with respect to the inner shaft **797** (or, alternatively, the inner shaft translates with respect to the outer shaft) using the control **798**. The translation of the outer shaft **794** (or the inner shaft **797**) operates the clamps **795**. When the outer shaft **794** moves away from the clamps **795**, the clamps separate to allow loading (or unloading) of the spacer **100** on the spacer insertion instrument **790**. When the outer shaft **794** moves toward the clamps **795**, the clamps are moved together to grip the spacer **100**. For example, the clamps **795** can grip the undercut notches **103** formed on opposite sides of the body **102** of the spacer **100**. In this manner, the spacer insertion instrument **790** can hold the spacer **100** for delivery of the spacer into position between adjacent spinous processes within the patient.

(36) Turning to FIG. **8**, a driver tool **880** includes a handle **882** at the proximal end and a spacer engaging bit **884** (for example, a socket key or hexagonal tip) at the distal end. The handle **882** and spacer engaging bit **884** are connected by a shaft **886**. The driver tool **880** is sized to be inserted into the central passageway **793** of the spacer insertion instrument **790** such that the spacer engaging bit **884** at the distal end operatively connects with a spacer **100** gripped by the clamps **795** of the spacer insertion instrument **790**. The spacer engaging bit **884** includes features for engaging with the shaped cavity **119** (see, for example. FIG. **2**) in the actuator screw **108** of the spacer **100**. In at least some embodiments, the driver tool **880** has a spacer engaging bit **884** that is complementary to the shaped cavity **119** in the actuator screw **108** of the spacer **100**. For example, the bit **884** can have a flat (like a regular screwdriver), cross (like a Phillips screwdriver), square, pentagonal, hexagonal, or octagonal shape (or any other suitable shape) with the shaped cavity **119** having a complementary shape. Rotating the driver tool **880** when engaged with the actuator screw **108** of the spacer **100** rotates the actuator screw **108** to separate the arms **104**, **106** of the spacer, as described above.

(37) In at least some embodiments, a small midline or lateral-to-midline incision is made in the patient for percutaneous delivery of the spacer **100**. In at least some embodiments, the supraspinous ligament is avoided. In at least some embodiments, the supraspinous ligament is split longitudinally along the direction of the tissue fibers to create an opening for the instrument. In at least some embodiments, one or more dilators may be used to create or enlarge the opening.

(38) In at least some embodiments, the spacer **100**, in the first deployed position, is releasably attached to the spacer insertion instrument **790** as described above. In at least some embodiments,

the spacer **100** is inserted into a port or cannula, if one is employed, which has been operatively positioned to form an opening to the interspinous space within a patient's back. The spacer **100**, attached to the spacer insertion instrument **790**, is inserted into the interspinous space between the spinous processes of two adjacent vertebral bodies. In at least some embodiments, the spacer **100** is advanced beyond the end of a cannula or, alternatively, the cannula is pulled proximately to uncover the spacer **100** connected to the spacer insertion instrument **790**. Once in position, the driver tool **880** is inserted into the spacer insertion instrument **790**, if not previously inserted, to engage the actuator screw **108**. The driver tool **880** is rotated to rotate the actuator screw **108**. The rotating actuator screw **108** changes the deployed position of the spacer **100**. Rotation in one direction, for example, clockwise, for example, increase the separation distance between the arms **104**, **106** (compare, for example, FIGS. **1**A and **1**B).
(39) The arms **104**, **106** of the spacer may be positioned in one of many deployed positions with different separation distances. In at least some, embodiments, the separation of the arms **104**, **106** can be reversed by rotating the actuator screw **108** in the opposite direction, for example, counterclockwise.
(40) In at least some embodiments, a clinician can observe with fluoroscopy or other imaging technique the positioning of the spacer **100** inside the patient and then choose to reposition the spacer **100**, if desired. Repositioning of the spacer may involve reversing, or partially reversing, the separation of the arms **104**, **106**. The spacer **100** may then be re-deployed into the desired location. This process can be repeated as necessary until the clinician has achieved the desired positioning of the spacer in the patient.
(41) Following deployment of the spacer, the spacer insertion instrument **790** and driver tool **880** (and any other instrumentation, such as a cannula or dilator) is removed from the body of the patient. The spacer insertion instrument **790** can be operated as described above to release the clamps **795** from the spacer **100**.
(42) The above specification provides a description of the manufacture and use of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention also resides in the claims hereinafter appended.

Claims

1. An interspinous spacer, comprising: a body having a distal portion, a proximal portion, a proximal surface, a channel extending longitudinally from the proximal surface, and at least one slot extending longitudinally along the distal portion; an arm actuator defining a threaded channel extending longitudinally, wherein the arm actuator is configured to fit within the body; an actuator screw comprising a shaft having a proximal end and a distal portion, wherein the actuator screw further comprises a head coupled to the proximal end of the shaft, wherein the distal portion of the shaft of the actuator screw is threaded and the actuator screw is at least partially disposed in the channel of the body and the threaded channel of the arm actuator, wherein, as the actuator screw is rotated using a driver tool, the arm actuator moves longitudinally relative to the body; a first pin, wherein the first pin is arranged to move along the at least one slot of the body; a second pin; and a first arm and a second arm, wherein each of the first and second arms comprises a bridge, at least two receiving extensions extending from the bridge in a first direction and configured for receiving a portion of a vertebra therebetween, and a coupling extension extending from the bridge in a second direction, wherein each of the coupling extensions defines a pin opening and a curved track, wherein the first and second arms are coupled to the distal portion of the body by the second pin extending through the curved tracks of the coupling extensions and further coupled to the distal portion of the body and the arm actuator by the first pin extending through the pin openings of the coupling extensions, wherein the first and second arms are configured to rotate among different deployment positions according to the curved track in response to longitudinal movement of the

arm actuator as the actuator screw is rotated.

2. The interspinous spacer of claim 1, wherein the actuator screw further comprises a disc disposed along the shaft distal to, and separated from, the head, wherein the shaft has an outer diameter that is smaller than outer diameters of the disc and the head.

3. The interspinous spacer of claim 2, wherein the disc comprises a plurality of teeth arranged around a perimeter of the disc.

4. The interspinous spacer of claim 3, further comprising at least one locking inset positioned within the channel of the body for engagement by the disc of the actuator screw, each of the at least one locking inset comprising at least one tooth for interaction with the teeth of the disc to limit rotation of the actuator screw absent the driver tool.

5. The interspinous spacer of claim 3, further comprising a locking ring configured for engagement with the actuator screw between the head and the disc to limit movement of the actuator screw proximally or distally within the channel of the body, wherein the body defines a bounded groove within the channel to receive the locking ring, wherein the locking ring is a partial or full ring.

6. The interspinous spacer of claim 1, wherein each of the first arm and the second arm comprises at least two of the coupling extensions.

7. The interspinous spacer of claim 6, wherein the coupling extensions of the first arm interleave with the coupling extensions of the second arm.

8. The interspinous spacer of claim 1, wherein the body comprises opposing undercut notches configured for receiving a clamp of a spacer insertion instrument.

9. The interspinous spacer of claim 1, wherein the actuator screw further comprises a shaped cavity formed in the head, wherein the shaped cavity is configured for receiving a bit of the driver tool that has a shape complementary to the shaped cavity.

10. A kit, comprising: the interspinous spacer of claim 1; a spacer insertion instrument configured to releasably grip the interspinous spacer for implantation into a patient; and the driver tool comprising a spacer engaging bit configured to engage the actuator screw of the interspinous spacer and rotate the actuator screw by rotation of the driver tool.

11. An interspinous spacer, comprising: a body having a distal portion, a proximal portion, a proximal surface, and a channel extending longitudinally from the proximal surface; an arm actuator defining a threaded channel extending longitudinally, wherein the arm actuator is configured to fit within the body; an actuator screw comprising a shaft having a proximal end and a distal portion, a head coupled to the proximal end of the shaft, and a disc disposed along the shaft distal to, and separated from, the head, wherein the distal portion of the shaft of the actuator screw is threaded and the actuator screw is at least partially disposed in the channel of the body and the threaded channel of the arm actuator, wherein the disc comprises a plurality of teeth arranged around a perimeter of the disc, wherein, as the actuator screw is rotated using a driver tool, the arm actuator moves longitudinally relative to the body; at least one locking inset positioned within the channel of the body for engagement by the disc of the actuator screw, each of the at least one locking inset comprising at least one tooth for interaction with the teeth of the disc to limit rotation of the actuator screw absent the driver tool; and a first arm and a second arm, wherein each of the first and second arms comprises a bridge, at least two receiving extensions extending from the bridge in a first direction and configured for receiving a portion of a vertebra therebetween, and a coupling extension extending from the bridge in a second direction, wherein each of the coupling extensions is coupled to the distal portion of the body and the arm actuator.

12. The interspinous spacer of claim 11, further comprising a locking ring configured for engagement with the actuator screw between the head and the disc to limit movement of the actuator screw proximally or distally within the channel of the body, wherein the body defines a bounded groove within the channel to receive the locking ring, wherein the locking ring is a partial or full ring.

13. The interspinous spacer of claim 11, wherein each of the first arm and the second arm

comprises at least two of the coupling extensions.
14. The interspinous spacer of claim 13, wherein the coupling extensions of the first arm interleave with the coupling extensions of the second arm.
15. The interspinous spacer of claim 11, wherein the body further comprises at least one slot extending longitudinally along the distal portion of the body, the interspinous spacer further comprising a first pin, wherein the first pin is arranged to move along the at least one slot of the body, wherein each of the coupling extensions defines a pin opening, wherein the first and second arms are coupled to the distal portion of the body and the arm actuator by the first pin extending through the pin openings of the coupling extensions.
16. The interspinous spacer of claim 15, further comprising a second pin, wherein each of the coupling extensions further defines a curved track, wherein the first and second arms are coupled to the distal portion of the body by the second pin through the curved tracks of the coupling extensions, wherein the first and second arms are configured to rotate relative to the body according to the curved track in response to longitudinal movement of the arm actuator as the actuator screw is rotated.
17. The interspinous spacer of claim 11, wherein the at least one locking inset comprises two locking insets disposed opposite each other.
18. The interspinous spacer of claim 11, wherein the body comprises opposing undercut notches configured for receiving a clamp of a spacer insertion instrument.
19. The interspinous spacer of claim 11, wherein the actuator screw further comprises a shaped cavity formed in the head, wherein the shaped cavity is configured for receiving a bit of the driver tool that has a shape complementary to the shaped cavity.
20. A kit, comprising: the interspinous spacer of claim 11; a spacer insertion instrument configured to releasably grip the interspinous spacer for implantation into a patient; and the driver tool comprising a spacer engaging bit configured to engage the actuator screw of the interspinous spacer and rotate the actuator screw by rotation of the driver tool.
