PAJUNK®

NerveGuard

Automatic system
for injection pressure limitation

Peripheral nerve blocks

MADE IN GERMANY

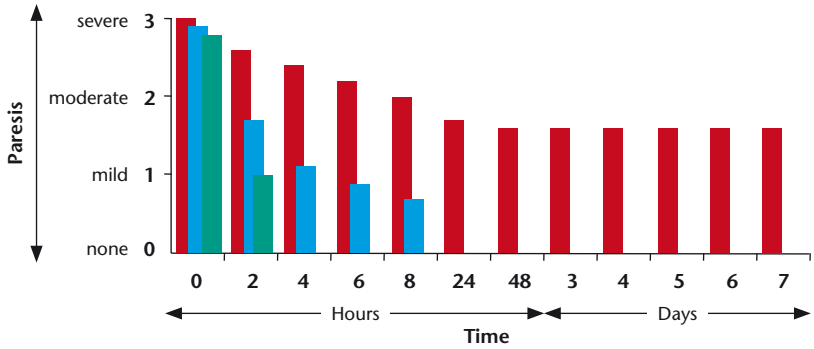
Causes and approaches

Avoiding nerve damage during peripheral nerve blocks

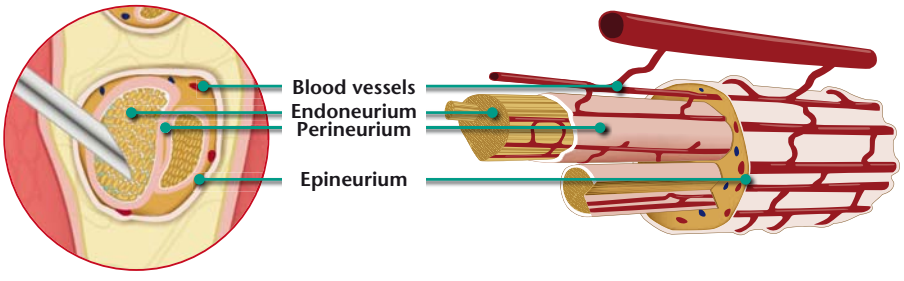
Ultrasound-guided localisation of peripheral nerves and the associated real-time visualisation provide crucial benefits in regional anaesthesia.[1] Nonetheless, it is clear that this does not reduce the incidence of permanent nerve damage.[2] Even in combination with nerve stimulation, intrafascicular injections cannot be ruled out.[1,3,4,5] The causes include incorrect positioning of the cannula along with exceeding critical injection pressures, as the following explanations show.

Causes of the development of nerve damage

1. Intrafascicular injections



The higher the injection pressure is during injections in the intrafascicular space, the more severe and longer lasting the resultant paresis is.[6]
If the pressure during intrafascicular injections exceeds a critical threshold of 15 psi, such injections may demonstrably lead to severe long-term neurological complications.[6,7,8] (Kapur[6]: > 20 psi, Hadzic[7]: > 25 psi, Hasanbegovic[8]: > 15.9 psi)



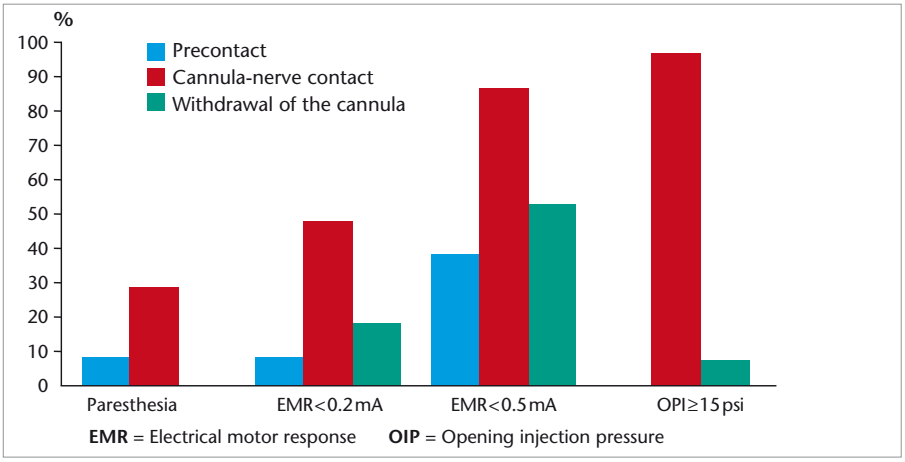
Intrafascicular injection

Effects: In the case of several hours lasting intrafascicular injections at high pressure, the microvascular blood supply of the nerve is severely restricted, which can lead to degeneration of nerve structures.[7,12]

➡ *Limiting the injection pressure to 15 psi avoids nerve damage.*

1 Choquet, Capdevila, Ultrasound-guided nerve blocks …, 2012 May; 114(5): 929–930
2 Neil et al., The Second American Society of Regional Anesthesia …, 2016 March–April; 41(2): 183
3 Robards et al., Intraneural injection with low-current stimulation …, 2009 Aug; 109(2): 673–677
4 Vassiliou et al., Risk evaluation for needle-nerve contact related …, 2016 Mar; 60(3): 400–406
5 Sites et al., Characterizing novice behavior associated with …, 2007 Mar–Apr; 32(2): 107–115
6 Kapur et al., Neurologic and histologic outcome …, 2007 Jan; 51(1): 101–107
7 Hadzic et al., Combination of intraneural injection …, 2004 September–October; 29(5): 417–423
8 Hasanbegovic et al., Effects of intraneural and perineural injection …, 2013; 3(3): 248

2. Cannula-nerve contact

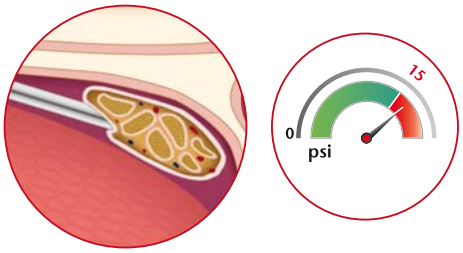


Incidence of paresthesias, motor evoked responses as well as exceeding the opening pressure threshold in the case of three different cannula positions.[10]

Effects: Direct cannula-nerve contact can also lead to damage of the neural structures with subsequent transient or permanent neurological impairment.[10,11] Localisation control using ultrasound and/or nerve stimulation may not in all cases reliably indicate direct cannula-nerve contact.

Paresthesia in and of itself is not regularly observed.[10] Avoiding direct cannula-nerve contact minimises the risk of damage to the nerve wall.[11]

➡ *A reliable indicator of direct cannula-nerve contact is an opening pressure of ≥ 15 psi.*



Cannula-nerve contact **Opening pressure**

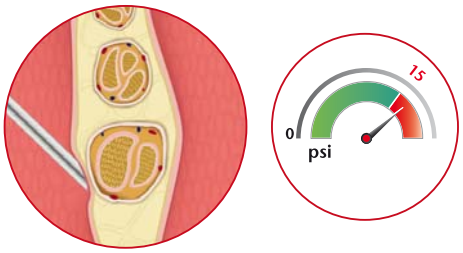
≥ 15 psi

The opening pressure in the case of direct cannula-nerve contact is ≥ 15 psi.

3. Cannula-fascia contact

Effects: Injections administered in the wrong tissue layers can also cause anaesthesia failures. An opening pressure of ≥ 15 psi may indicate occlusion of the tip of the cannula due to fascia in front of it.[9]

➡ *To prevent injections in the wrong tissue layers close to the nerve, the critical threshold is an opening pressure of 15 psi.*



Cannula-fascia contact **Opening pressure**

≥ 15 psi

Blockage of the cannula opening by the fascia.

9 Gadsden et al., High Opening Injection Pressure is Associated With Needle-Nerve …, 2016 Jan–Feb; 41(1): 50–55
10 Gadsden et al., Opening injection pressure consistently detects needle-nerve contact …, 2014 May; 120(5): 1246–1253
11 Steinfeldt et al., Histological consequences of needle-nerve contact following nerve stimulation …, 2011; Article ID 591851: 0–9
12 Lundborg et al., Nerve compression injury and increased endoneurial fluid pressure …, 1983 Dec; 46(12): 1119–1124

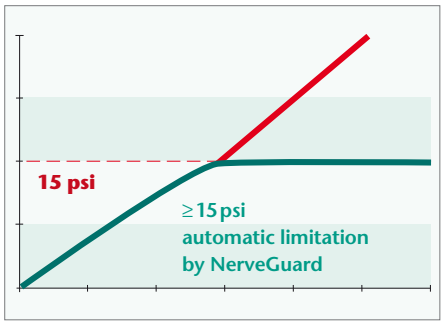
NerveGuard

The automatic injection pressure limiter

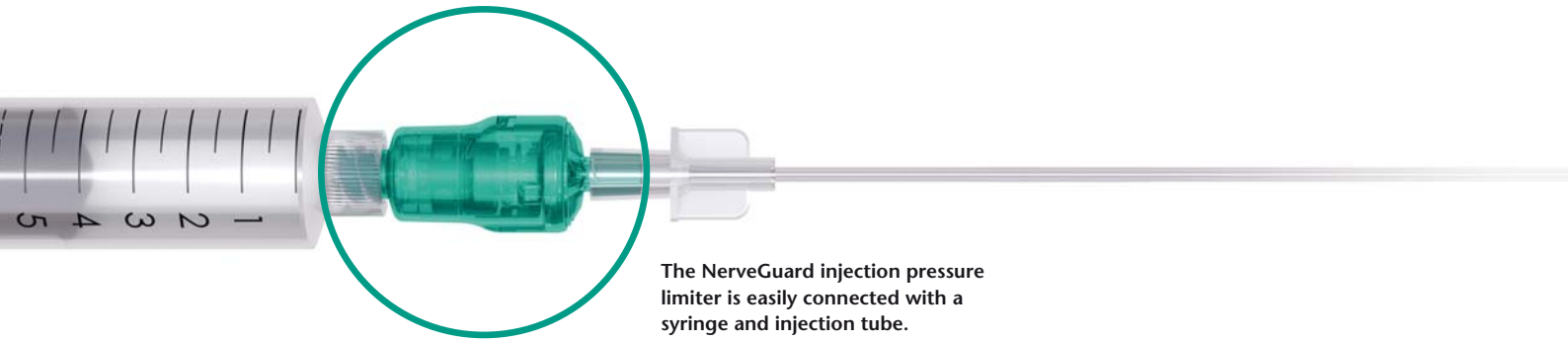
With the automatic injection pressure limiter NerveGuard, PAJUNK® addresses the issue of preventive position control. If the opening or injection pressure reaches the specified threshold of 15 psi, the administration of anaesthetic is automatically stopped. In this way, incorrect positioning of the cannula can be detected and corrected immediately and in addition an injection performed using too much pressure can be avoided as far as possible.

- *Blocks the injection automatically at 15 psi*
- *No monitoring and no visual control necessary*
- *Suitable for single-step and continuous peripheral nerve blocks*

NerveGuard
Injection pressure limiter



If the system pressure reaches the defined threshold of 15 psi, the valve of the NerveGuard closes automatically and administration of the anaesthetic is blocked.



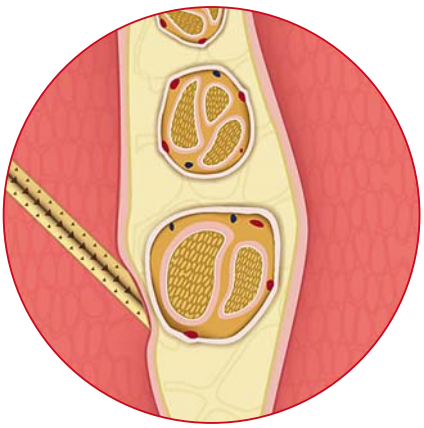
The NerveGuard injection pressure limiter is easily connected with a syringe and injection tube.

PAJUNK® cannula

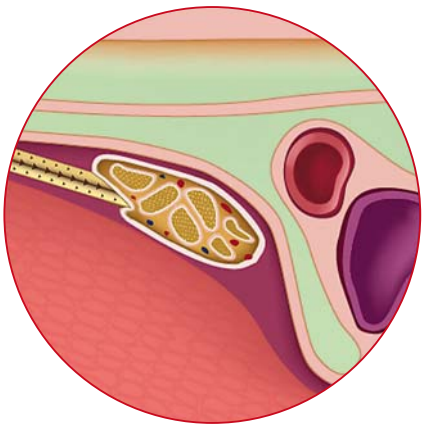
The user can concentrate on the puncture and the ultrasound device.
➡ No additional "eye contact" with the NerveGuard is necessary.

Preventive position control through NerveGuard

NerveGuard offers additional support in the localisation of the cannula tip and prevents nerve damage, together with the automatic pressure limitation.

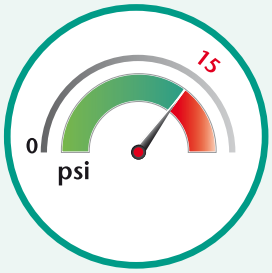


Cannula-fascia contact
during interscalene blocks
Opening pressure ≥ **15 psi**
Indicates occlusion of the tip of the cannula as a result of fascia in front of it.[9]



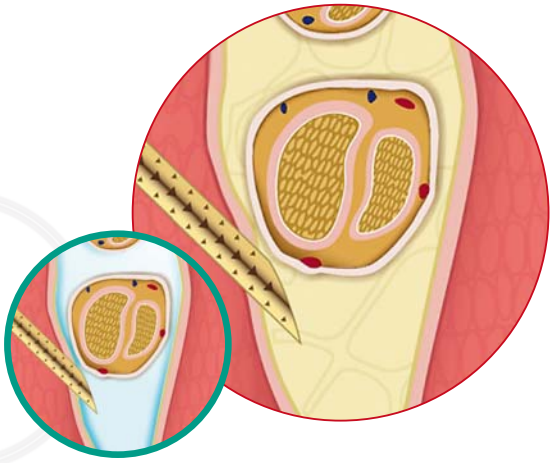
Cannula-nerve contact
during femoral nerve blocks
Opening pressure ≥ **15 psi**
Indication of direct cannula-nerve contact.[10]

Pressure measurement at 15 psi – as far as it will go at red
Valve of the NerveGuard closes automatically.

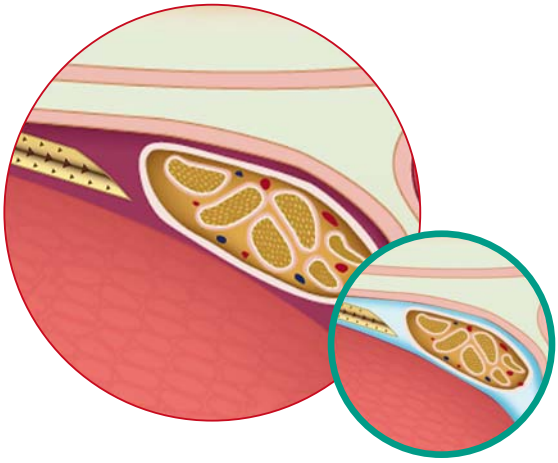


➡ Administration of the anaesthetic is noticeably blocked.
➡ As soon as the pressure drops when the cannula is withdrawn, the valve reopens.

Position correction through withdrawal/repositioning of the cannula



➡ The tip of the cannula pierces the fascia and is now in the optimal position for an injection.



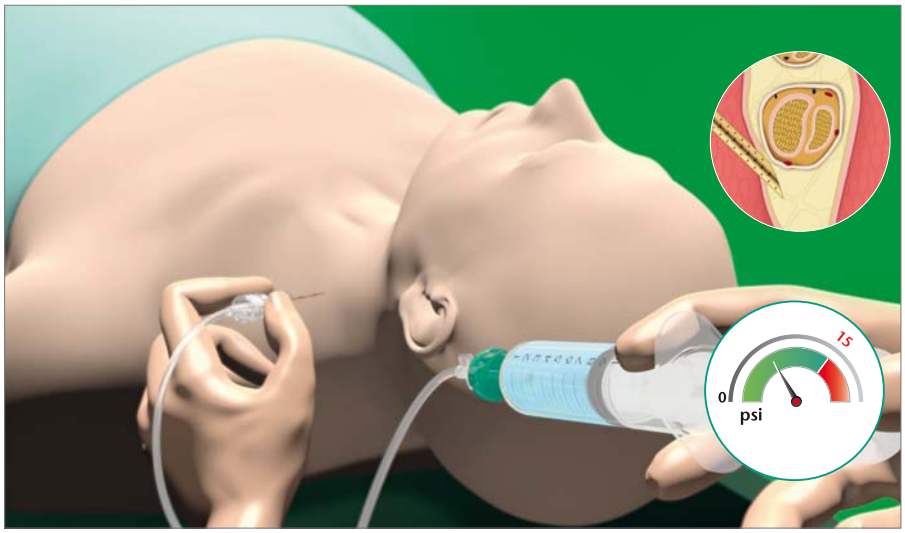
➡ Avoiding an injection when there is direct cannula-nerve contact minimises the risk of damage to the nerve wall.[11]

➡ *The injection is successful – the anaesthetic spreads around the nerve.*

9 Gadsden et al., High Opening Injection Pressure is Associated With Needle-Nerve …, 2016 Jan–Feb; 41(1): 50–55
10 Gadsden et al., Opening injection pressure consistently detects needle-nerve contact …, 2014 May; 120(5): 1246–1253
11 Steinfeldt et al., Histological consequences of needle-nerve contact following nerve stimulation …, 2011; Article ID 591851: 0–9

All-round solution

The connection between preventive position control and precise localisation

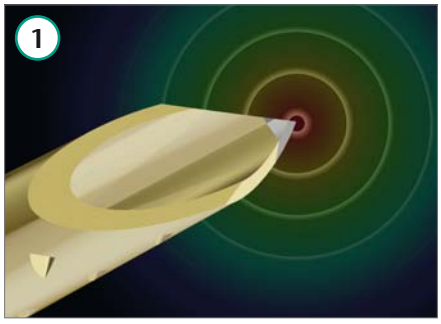


Automatic injection pressure limitation with NerveGuard

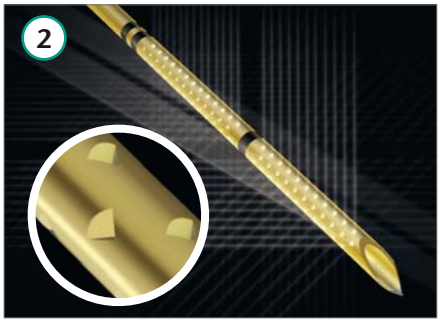
- ➡ *Detects incorrect cannula positioning (fascia or nerve contact)*
- ➡ *Prevents intrafascicular injections in cases of excessive pressure*
- ➡ *Automatically blocks injections when the injection pressure ≥ 15 psi*
- ➡ *Provides important information regarding position correction*
- ➡ *Avoids nerve damage and increases patient safety*

"Things just got a whole lot smarter."

NerveGuard – just to be safe!



High-precision stimulation using NanoLine thin layer technology



Excellent echogenicity with ultrasound cannulas (Cornerstone reflectors)

Preventive position control to avoid nerve damage with NerveGuard

Three innovative techniques to protect the nerves during injections:
NanoLine thin layer technology I Cornerstone reflectors I NerveGuard = NERVE PROTECT 3

Studies

- **Adams A.** Injection Pressure Monitoring & Injection Technique in Peripheral Nerve Blockade, Anaesth. J. of the AAGBI 2015 Nov; 70(2)

- **Choquet O., Capdevila X.** Ultrasound-guided nerve blocks: the real position of the needle should be defined, Anaesth. Analg. 2012 May; 114(5): 929–930

- **Gadsden J., Choi J.J., Lin E., Robinson A.** Opening injection pressure consistently detects needle-nerve contact during ultrasound-guided interscalene brachial plexus block, Anesthesiology 2014 May; 120(5): 1246–1253

- **Gadsden J., Latmore M., Levine D.M., Robinson A.** High Opening Injection Pressure is Associated With Needle-Nerve and Needle-Fascia Contact During Femoral Nerve Block, Reg. Anesth. Pain Med. 2016 Jan–Feb; 41(1): 50–55

- **Hadzic A., Dilberovic F., Shah S., Kulenovic A., Kapur E., Zaciragic A., Cosovic E., Vuckovic I., Divanovic K.A., Mornjakovic Z., Thys D.M., Santos A.C.** Combination of intraneural injection and high injection pressure leads to fascicular injury and neurologic deficits in dogs, Reg. Anesth. Pain Med. 2004 September–October; 29(5): 417–423

- **Hasanbegovic I., Kulenovic A., Hasanovic S.** Effects of intraneural and perineural injection and concentration of ropivacaine on nerve injury during peripheral nerve block in wistar rats, J. of Health Sciences 2013; 3(3): 243–249

- **Kapur E., Vuckovic I., Dilberovic F., Zaciragic A., Cosovic E., Divanovic K.A., Mornjakovic Z., Babic M., Borgeat A., Thys D.M., Hadzic A.** Neurologic and histologic outcome after intraneural injections of lidocaine in canine sciatic nerves, Acta. Anaesthesiol. Scand. 2007 Jan; 51(1): 101–107

- **Lundborg G., Myers R., Powell, H.** Nerve compression injury and increased endoneurial fluid pressure: a „miniature compartment syndrome", J. Neurol. Neurosurg. Psychiatry 1983 Dec; 46(12): 1119–1124

- **Neil J.M., Brull R., Horn J.L., Liu S.S., McCartney C.J., Perlas A., Salinas F.V., Tsui B.C.** The Second American Society of Regional Anesthesia and Pain Medicine Evidence-Based Medicine Assessment of Ultrasound-Guided Regional Anesthesia, Reg. Anaesth. Pain Med. 2016 March–April; 41(2): 181–194

- **Patil J., Ankireddy H., Wilkes A., Williams D., Lim M.** An improvised pressure gauge for regional nerve blockade/anesthesia injections: an initial study, J. Clin. Monit. Comput. 2015 Dec; 29(6): 673–679

- **Patil J.J., Ford S., Egeler C., Williams D.J.** The effect of needle dimensions and infusion rates on injection pressures in regional anaesthesia needles: a bench-top study, Anaesth. 2015; 70: 183–189

- **Robards C., Hadzic A., Somasundaram L., Iwata T., Gadsden J., Xu D., Sala-Blanch X.** Intraneural injection with low-current stimulation during popliteal sciatic nerve block, Anesth. 2009 Aug; 109(2): 673–677

- **Ross S., Edwards K., McFadden K., Bigeleisein P.E., Orebaugh S.L.** Pressures of Injection in a Cadaver Model of Peripheral Nerve Blockade, J. Anesth. Clin. Res. 2014; 5: 10

- **Sites B.D., Spence B.C., Gallagher J.D., Wiley C.W., Bertrand M.L., Blike G.T.** Characterizing novice behavior associated with learning ultrasound-guided peripheral regional anesthesia, Reg. Anesth. Pain Med. 2007 Mar–Apr; 32(2): 107–115

- **Steinfeldt T., Graf J., Schneider J., Nimphius W., Weihe E., Borgeat A., Wulf H., Wiesmann T.** Histological consequences of needle-nerve contact following nerve stimulation in a pig model, Anesth. Research and Practice 2011; Article ID 591851: 0–9

- **Vassiliou T., Müller H.H., Limberg S., De Andres J., Steinfeldt T., Wiesmann T.** Risk evaluation for needle-nerve contact related to electrical nerve stimulation in a porcine model, Acta Anaesthesiol. Scand. 2016 Mar; 60(3): 400–406

NerveGuard

All information at a glance

NerveGuard

NerveGuard injection pressure limiter, single, sterile

Art. no.	PU
001151-38M	10

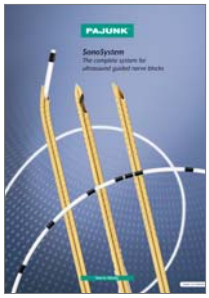
Compatible with PAJUNK® cannulas

for single shot applications in diameters of 20 G/21 G/22 G

Product	Size	Art. no.	PU
UniPlex NanoLine			
Facet grinding	22 G x 40 mm	001156-70	10
	22 G x 50 mm	001156-74	10
	22 G x 80 mm	001156-71	10
	22 G x 100 mm	001156-84	10
	22 G x 120 mm	001156-82	10
	21 G x 80 mm	001156-88	10
	21 G x 100 mm	001156-77	10
	20 G x 120 mm	001156-72	10
	20 G x 150 mm	001156-76	10
UniPlex NanoLine			
SPROTTE®	22 G x 40 mm	001156-31G	10
	22 G x 70 mm	001156-31H	10
	22 G x 90 mm	001156-31J	10
	22 G x 150 mm	001156-28L	10
SonoPlex			
Facet grinding	22 G x 40 mm	001185-70	10
	22 G x 50 mm	001185-74	10
	22 G x 80 mm	001185-71	10
	21 G x 80 mm	001185-88	10
	21 G x 100 mm	001185-77	10
	20 G x 120 mm	001185-72	10
	20 G x 150 mm	001185-76	10

Product	Size	Art. no.	PU
SonoPlex			
SPROTTE®	22 G x 50 mm	001185-31G	10
	22 G x 70 mm	001185-31H	10
	22 G x 90 mm	001185-31J	10
SonoBlock			
Facet grinding	22 G x 40 mm	001180-70	10
	22 G x 50 mm	001180-74	10
	22 G x 80 mm	001180-71	10
	21 G x 100 mm	001180-77	10
	20 G x 120 mm	001180-72	10
SonoBlock			
SPROTTE®	22 G x 50 mm	001180-31G	10
	22 G x 70 mm	001180-31H	10
	22 G x 90 mm	001180-31J	10
SonoTAP			
Facet grinding	22 G x 50 mm	1185-3E050	10
	22 G x 80 mm	1185-3E080	10
	21 G x 110 mm	1185-3F110	10
	21 G x 150 mm	1185-3F150	10

For continuous applications compatible with PAJUNK® cannulas in diameters of 18 G/19 G



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