# veterinary technology for life

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# **Zlig** Intra-Articular Cruciate Ligament Replacement Technique (CrCL)





#### **ZLIG INTRA-ARTICULAR CRUCIATE LIGAMENT REPLACEMENT** - COMPONENTS

#### The history

The tear of the cranial cruciate ligament is still one of the most common orthopaedic diseases in dogs. The path of the many surgical methods developed for this vary between intracapsular and extracapsular techniques to modern corrective osteotomies that alter the geometry of the affected knee joint. With the development of new materials in medical technology, it is now possible to replace the cranial cruciate ligament in an anatomically correct manner, instead of changing the forces acting on the joint. After a long period of preparatory work by the French Dr Jacques-Phillipe Laboureau, a suitable synthetic ligament is now available for the intra-articular cruciate ligament replacement in small animals. Together with the instrumentation developed by EICKEMEYER®, this new technique for cruciate ligament replacement can now be performed.

#### The implant

The Zlig consists of ultra-high-molecular polyethylene with the special feature that the woven structure of the implant is interrupted intra-articularly be "free fibres". Free parallel fibres reduce fatigue and encourage the ingrowth of fibroblasts and collagen. Each implant is delivered in a sterile packed sleeve, making it easier to handle the implant before it is inserted into the joint. A selection of sizes with different resistances and fibre lengths are available to fit different patient sizes.

16 fibres / 10 mm ▶ 5-8 kg ▶ 2,000 N 191501	<ul> <li>48 fibres / 19 mm</li> <li>25 - 45 kg</li> <li>6,000 N</li> <li>191504</li> </ul>
<ul> <li>24 fibres / 15 mm</li> <li>8-12 kg</li> <li>3,000 N</li> <li>191502</li> </ul>	<ul> <li>48 fibres / 22 mm</li> <li>25-45 kg</li> <li>6,000 N</li> <li>191505</li> </ul>
<b>32 fibres / 17 mm</b> ▶ 12 – 25 kg ▶ 4,000 N <b>191503</b>	<ul> <li>48 fibres / 25 mm</li> <li>25 - 45 kg</li> <li>6,000 N</li> <li>191506</li> </ul>

#### The technology

In this technique, an artificial ligament is used as a total replacement for the cranial cruciate ligament using tunnel-tunneltechnique. The ligament is fixed in the tibia and Os femoris using specially developed cannulated interference screws in drill channels. The screws are guided parallel to the ligament using a guiding wire to avoid deviations. The technology does not cause irreversible damage and the results are reproducible thanks to a quick learning curve. Another great advantage of the technique is the fact that patients can put weight on the hind leg immediately after the operation without any risks.



191506

Example

#### **ZLIG INTRA-ARTICULAR CRUCIATE LIGAMENT REPLACEMENT** - COMPONENTS

#### The instrumentation

A small and inexpensive set of instruments is required to perform this new and innovative cruciate ligament surgery method. The threads of the specially developed titanium interference screws are round so they do not cause any damage to the fibres of the Zlig.

#### **Titanium Interference Screws**

- Cannulated
- 4 Titanium Interference Screws Ø 3.0 mm, blue (8 mm)
- 12 Titanium Interference Screws Ø 3.5 mm, light blue (from 8 – 13 mm)
- 12 Titanium Interference Screws Ø 4.0 mm, magenta (from 8 – 13 mm)
- 16 Titanium Interference Screws Ø 4.5 mm, gold (from 10 – 25 mm)
- 8 Titanium Interference Screws Ø 5.0 mm, green (15 & 20 mm)
- 8 Titanium Interference Screws Ø 6.0 mm, silver (10 & 20 mm)

#### 191535 - 191538 / 191540 - 191542 / 191545 - 191548 /

191563 / 191566 - 191568



191508







191567

# **ZLIG INTRA-ARTICULAR CRUCIATE LIGAMENT REPLACEMENT** – ITEM LIST

Zlig Screw and Instrument Set			
ltem No.	Description	Quantity	
191508	Complete set, consisting of:		
191510	Zlig Instrument Tray, without instruments	1	
191530	Interference Screw Container, with lid, without screws	1	
191511	Twist Drill, Ø 2.5 mm, cannulated, Ø cannulation 1.2 mm, round shaft	1	
191512	Twist Drill, Ø 3.0 mm, cannulated, Ø cannulation 1.2 mm, round shaft	1	
191516	Twist Drill, Ø 3.6 mm, cannulated, Ø cannulation 2.2 mm, round shaft	1	
191514	Twist Drill, Ø 4.2 mm, cannulated, Ø cannulation 2.2 mm, round shaft	1	
191515	Twist Drill, Ø 5.0 mm, cannulated, Ø cannulation 2.2 mm, round shaft	1	
191513	Twist Drill, Ø 4.0 mm, not cannulated, round shaft	1	
191957	Screwdriver Blade, Hex 2.0, cannulated, AO Quick Coupling	1	
191509	Screwdriver Blade, Hex 2.5, cannulated, AO Quick Coupling	1	
191958	Silicone Screwdriver Handle, cannulated, AO Quick Coupling, L 140 mm	1	
191517	Hexagon KIRSCHNER Wire, SW 2.5, L 150 mm	1	
191518	Attachment for hexagon KIRSCHNER Wire, Hex 2.5, AO Quick Coupling	1	
191519	KIRSCHNER Wire, Ø 1.0 x L 190 mm, trocar / trocar	2	
191520	KIRSCHNER Wire, Ø 1.0 x L 190 mm, blunt / blunt	2	
191521	KIRSCHNER Wire, Ø 1.8 x L 190 mm, trocar / trocar	2	
191522	KIRSCHNER Wire, Ø 1.8 x L 190 mm, blunt / blunt	2	
191524	Tube for Wire Loop, Ø 2.5 x L 150 mm, cannulated, Ø cannulation 2.0 mm	1	
191525	Tube for Wire Loop, Ø 3.5 x L 150 mm, cannulated, Ø cannulation 2.5 mm	1	
191926	Wire Loop, Ø 0.5 x L 600 mm	2	
191535	Titanium Interference Screw, Ø 3.0 x L 8 mm, cannulated, Ø cannulation 1.1 mm, blue, Hex 2.0	4	
191538	Titanium Interference Screw, Ø 3.5 x L 8 mm, cannulated, Ø cannulation 1.1 mm, light blue, Hex 2.0	4	
191536	Titanium Interference Screw, Ø 3.5 x L 10 mm, cannulated, Ø cannulation 1.1 mm, light blue, Hex 2.0	4	
191537	Titanium Interference Screw, Ø 3.5 x L 13 mm, cannulated, Ø cannulation 1.1 mm, light blue, Hex 2.0	4	
191540	Titanium Interference Screw, Ø 4.0 x L 8 mm, cannulated, Ø cannulation 1.1 mm, magenta, Hex 2.0	4	
191541	Titanium Interference Screw, Ø 4.0 x L 10 mm, cannulated, Ø cannulation 1.1 mm, magenta, Hex 2.0	4	
191542	Titanium Interference Screw, Ø 4.0 x L 13 mm, cannulated, Ø cannulation 1.1 mm, magenta, Hex 2.0	4	
191545	Titanium Interference Screw, Ø 4.5 x L 10 mm, cannulated, Ø cannulation 1.1 mm, gold, Hex 2.5	4	
191546	Titanium Interference Screw, Ø 4.5 x L 15 mm, cannulated, Ø cannulation 1.1 mm, gold, Hex 2.5	4	
191547	Titanium Interference Screw, Ø 4.5 x L 20 mm, cannulated, Ø cannulation 1.1 mm, gold, Hex 2.5	4	
191548	Titanium Interference Screw, Ø 4.5 x L 25 mm, cannulated, Ø cannulation 1.1 mm, gold, Hex 2.5	4	
191566	Titanium Interference Screw, Ø 5.0 x L 15 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	4	
191568	Titanium Interference Screw, Ø 5.0 x L 20 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	4	
191563	Titanium Interference Screw, Ø 6.0 x L 10 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	4	
191567	Titanium Interference Screw, Ø 6.0 x L 20 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	4	

Optional Accessories		
ltem No.	Description	Quantity
191531	Titanium Interference Screw, Ø 3.0 x L 5 mm, cannulated, Ø cannulation 1.1 mm, blue, Hex 2.0	1
191533	Titanium Interference Screw, Ø 3.0 x L 10 mm, cannulated, Ø cannulation 1.1 mm, blue, Hex 2.0	1
191572	Titanium Interference Screw, Ø 4.0 x L 18 mm, cannulated, Ø cannulation 1.1 mm, magenta, Hex 2.0	1
191573	Titanium Interference Screw, Ø 4.5 x L 30 mm, cannulated, Ø cannulation 1.1 mm, gold, Hex 2.5	1
191544	Titanium Interference Screw, Ø 5.0 x L 10 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	1
191564	Titanium Interference Screw, Ø 5.0 x L 25 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	1
191574	Titanium Interference Screw, Ø 5.0 x L 30 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	1
191575	Titanium Interference Screw, Ø 5.0 x L 35 mm, cannulated, Ø cannulation 2.9 mm, green, Hex 2.5	1
191565	Titanium Interference Screw, Ø 6.0 x L 15 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	1
191569	Titanium Interference Screw, Ø 6.0 x L 25 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	1
191570	Titanium Interference Screw, Ø 6.0 x L 30 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	1
191571	Titanium Interference Screw, Ø 6.0 x L 35 mm, cannulated, Ø cannulation 2.9 mm, silver, Hex 2.5	1
180500	Template with V-slot, for KIRSCHNER wires Ø 0.6-2.5 mm and screws from 3-45 mm, stainless steel	1
191990	X-Ray Reference Ball Holder, Ø 25 mm, stainless steel, suitable for digital and analog systems	1

#### **Case Report**

**Dr. Christoph Werner**, Freilassing, Germany, February 19th, 2020 Shih Tzu cross "Pauline", female, 6.6 kg, 8 years, right knee

Zlig synthetic ligament used: CCL16/10 10 mm fibre length, Drill Ø 3.6 mm cannulated, screws: diagonal femur Ø 3.5 x 13 mm, transversal Ø 3.5 x 10 mm, diagonal tibia Ø 3.5 x 10 mm, transversal Ø 3.5 x 8 mm.





X-Ray Reference Ball Holder, Ø 25 mm (Item No. 191990), stainless steel, for implants or examining structures, using digital or analog systems (Fig. 1 and 1a).

#### 1. Diagonal drill, femoral channel



Access is performed through a medial arthrotomy, in which an incision is made in the joint capsule one centimetre medial to the patellar tendon. The patella is laterally luxated and the menisci are examined and, if necessary, resected / partially resected. The fat pad is partially removed to enable a better view if necessary. In this case, as it is a small dog, a guide KIRSCHNER wire trocar / trocar with Ø 1.0 mm (Item No. 191519) is placed in the condylar notch (otherwise use Ø 1.8 mm wire), which runs over the tibial cruciate ligament attachment. This is then drilled through the condyle to emerge on its lateral side (Fig. 2 and 2a).

#### Practical tip:

The proximal attachment of the cruciate ligament can often still be seen in the intercondylar fossa. It serves as a landmark for the planned entry point of the trocar. It is important that the drilling wire lies directly on the proximal edge of the tibia with full knee flexion to achieve the necessary angle to emerge laterally from the proximal end of the trochlea.



The Ø 3.6 mm cannulated drill (Item No. 191516) is then placed at the proximal end of the KIRSCHNER wire to drill a tunnel from the lateral side of the condyle towards the intracondylar notch. The hole must end just above the tibial plateau in order not to damage it. The drill is removed. The KIRSCHNER wire is left in the drilling channel (Fig. 3).

#### Practical tip:

The knee should be bent as much as possible when drilling to prevent the structures of the tibial plateau from being damaged if the drill comes out too far.

#### Attention:

Never insert the ligament immediately after drilling the canal through the femoral condyle, otherwise the ligament can be damaged in the second step (tibial canal).

#### 2. Determine the screw length of the femoral canal

The length of the femoral canal is measured with the KIRSCHNER wire left in the drilling canal, which now acts as a depth gauge (Item No. 187737), to determine the screw length (Fig. 14 and 15). If the length of the drilling channel is between two screw lengths, the shorter screw should be selected, which is screwed in flush up to the cis cortex.

#### 3. Diagonal drilling, tibial channel





In this case the two-channel drilling technique was chosen (Fig. 4 and 4a).

The two-channel drilling technique may be necessary in some circumstances – for example, if the tibial channel cannot be drilled to a sufficient length (i. e. the hole comes out of the tibia too far distally >3 cm) via the one-channel drilling technique through the femoral bone channel. With the two-channel drilling technique, the tibia drill hole is made with the knee in full flexion. First, the Ø 1.0 mm (guide wire trocar / trocar (Item No. 191519) is placed on the tibial footprint of the anterior cruciate ligament and aligned in its inclination, so that the guide wire emerges medially about 2 - 3 cm below the tibial plateau. Drilling is carried out with the Ø 3.6 mm cannulated drill from the tibial plateau. This has the advantage that the structures of the knee joint (condyles, caudal cruciate ligament, etc.) cannot be damaged due to the direction of drilling. The drill is removed, the guide wire remains in the drill channel.

#### 4. Pull the ligament into the joint through the tibial drilling channel



Pull the ligament into the joint through the tibial drilling channel Starting from the tibial plateau, the Ø 2.0 mm tube is now pushed over the KIRSCHNER wire to guide the wire loop (Item No. 191524). The KIRSCHNER wire is removed. The wire loop is inserted from the tibial plateau as shown here ... (Fig. 5)



... to pull the sterile artificial ligament (Item No. 191501) into the joint from the distal end through the drill channel (Fig. 6).

#### 5. Pull the ligament out of the joint through the femoral drilling channel



As before on the tibia, the  $\emptyset$  2.0 mm tube (Item No. 191524) is now placed from proximal to distal in the femoral tunnel and the wire loop (Item No. 191926) is then inserted (Fig. 7).

#### Practical tip:

If there are problems with the insertion of the tube: simply use the drill wire again for guidance!



The loose end of the artificial ligament is threaded into the wire loop and then pulled proximally through the femoral drilling channel (Fig. 8).

The artificial ligament is aligned (image). The loose free fibres of the ligament are placed intra-articularly (Fig. 9).

#### 6. Determine the screw length of the femoral canal

The length of the femoral canal was previously measured with a depth gauge (Item No. 187737) to determine the screw length (Fig. 14 and 15). If the length of the drilling channel is between two screw lengths, the shorter screw should be selected, which is screwed in flush up to the cis cortex.

#### 7. Place the guide wire for the screw

Here you see the KIRSCHNER wire blunt / blunt  $\emptyset$  1.0 mm (Item No. 191520). The guide wire should only be inserted according to the measured screw length so that it does not drive into the joint when the screw is screwed in. The screw is carefully screwed in over this guide wire.

#### Important:

The blunt KIRSCHNER wire is positioned laterally from and parallel to the synthetic band in the drill channel. It is therefore located laterally to the replacement ligament. This prevents the ligament from running over the screw head later, which could lead to fraying.

#### Practical tip:

The start and end of the free fibres on the ligament can be marked with an operating marker. This makes it easier to identify them when in the knee joint!

#### 8. Screw in the femoral canal screw



The length of the drill channel determines the screw length. The thickness is determined by the drill used. The Ø 3.5 x 13 mm cannulated interference screw is screwed over the blunt guide wire with the cannulated screwdriver onto the lateral condyle until it lies flush with the bone (Fig. 10 and 10a).

#### 9. Transverse drilling, femoral channel

The transverse drill channel in the femur is prepared. Here the  $\emptyset$  1.0 mm KIRSCHNER trocar / trocar wire is drilled into the femoral metaphysis one or two centimetres above the tunnel from lateral to medial (Fig. 11) ...



... and then drilled with the Ø 3.6 mm cannulated drill (Fig. 12).



The drill is removed while the Ø 1.0 mm guide wire remains in the drill channel. The Ø 2.0 mm tube for guiding the wire loop is pushed over it from the medial side. The wire loop (Item No. 191926) is inserted from the medial side, the free end of the band is inserted into the end of the loop and then pulled medially through the tube. The tube is removed (Fig. 13).

#### Practical tip:

Make sure that the ligament does not "twist". For safety, a longitudinal mark can be made on one side of the band with an operating marker pen before starting the operation!



The Ø 1.0 mm blunt / blunt KIRSCHNER wire is inserted into the transverse drill hole to measure its length. Check at the exit point with the finger whether the KIRSCHNER wire appears in the drill hole: the entry point of the wire is fixed with a forceps (Fig. 14).

The length of the bone canal can thus be easily determined (here using the V-slot template, Item No. 180500). It determines the length of the interference screw (Fig. 15).

#### Practical tip:

It is advisable to determine the lengths of all drill channels and have them noted!



Next the Ø 3.5 x 10 mm screw is screwed in laterally with the cannulated screwdriver (Item No. 191958) and the cannulated screwdriver blade (Item No. 191957) over the guide KIRSCHNER wire. Please note that this time the screw is inserted proximally from the band (see Fig. 9)! The ligament is kept under tension on the opposite side (Fig. 16).

#### 10. Screw in the transverse femoral screw



The interference screw is screwed into the transverse femoral tunnel until it is flush with the bone. The free end of the replacement ligament is then cut off medially near the bone surface (Fig. 17).



11. Checking the anterior drawer ...



The knee joint is then rinsed with plenty of sterile saline solution. The patella is placed in the trochlea (Fig. 18).

The knee joint is positioned in a 130° flexion. The free, loose ligament end at the tibia exit is held under tension with a clamp while the knee joint is extended and flexed to check whether the tension of the ligament allows the joint to move freely. The removal of the anterior drawer is checked (Fig. 19).

#### 12.... and isometry

The clamp is released, and the ligament is held under tension with the thumb and index finger directly at the exit. The previous step is repeated. The ligament must not tighten or loosen under flexion and extension – this is the only way to ensure that the isometric nature of the ligament has been reached!

#### 13. Screw in the tibial canal screw



The clamp is removed, the knee remains in the 130° position and the ligament is held distally under tension. This facilitates insertion of the blunt guide wire proximal to the ligament. The cannulated interference screw, whose length is measured as before can now be screwed into the drill channel via this guide wire to secure the band (Fig. 20).

#### Practical tip:

The blunt guide wire can also be used to check whether the screw protrudes into the joint gap by inserting it into the drill hole from the proximal end.

#### 14. Transverse drilling, tibial channel



The transverse drill channel through the tibia is first made with the drill wire 1 cm below the exit of the ligament replacement. Then it is widened to  $\emptyset$  3.6 mm with the cannulated drill (Fig. 21).



The interference screw length is again determined using a KIRSCHNER wire (Fig. 22).



The drill is removed while the guide wire with a diameter of 1.0 mm is left in the bone canal. The Ø 2.0 mm tube is pushed over it. The wire loop (Item No. 191926) is inserted laterally, the free end of the band is placed in the end of the loop and pulled laterally through the drill hole (Fig. 23).

#### 15. Screw in the transverse tibial screw



The thickness of the cannulated interference screw is determined by the bone canal, in this case a  $\emptyset$  3.5 mm x 8 mm screw. The guide wire is inserted from the medial side of the tibia. It is important that this time it runs distal to the ligament replacement. The screw is screwed in until it is flush with the bone surface. Both loose ends of the ligament can now be cut close to the bone (Fig. 24).

#### 16. Wound closure



The joint capsule, the fascia and the subcutaneous tissue are sutured with absorbable suture, the skin is closed with non-absorbable suture material (Fig. 25).







Enlarged section of Fig. 26 Lateral view (Fig. 26a)



This Z-shaped arrangement is mechanically very strong. It enables the immediate resumption of joint activity in every dog (Fig. 27).

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Lateral view (Fig. 28)



Lateral view with X-Ray reference sphere Ø 25 mm (Item No. 191990) (Fig. 29)



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# **ZLIG INTRA-ARTICULAR CRUCIATE LIGAMENT REPLACEMENT** – VIDEOS

Zlig application video



Zlig post-operative videos



German Shepherd Cross "Lieserl"



Labrador Retriever "Bonny"



Shih Tzu "Pauline"



Cocker Spaniel "Indie"

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