TUREMOS
Proximal Femur
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TUREMOS proximal femur

TUREMOS is a modular bone replacement system consisting of a variety of implants which, individually combined, replace selected bone segments.

An elaborated system allows for length adjustment in steps of 5 mm and gives the possibility to reconstruct the femur from 80 mm to 500 mm. With the extendable taper mechanism of the different components not only proximal defects can be replaced but also total femurs.

The fixation in the proximal femur is achieved with slightly conical stems, in the distal area with expansion stems. Both stems are rotationally stable and give primary stability. The ante torsion and correct position to the acetabulum are adjusted freely and secured.

The anchoring and the expansion stems are oversized by 1 mm of surface structure and coating compared to their spiral and fluted drills. Anchor stem have self-cutting, spiral threads, expansion stem have longitudinal flanges for rotational stability.

1. Indication

- Primary and secondary tumors in and around the proximal femur.
- Primary and secondary osteomyelitis.
- Revision of prosthetic stems with insufficient bone stock.
- Failed revisions.
- Extension of the femur, especially after failed correction of coxa vara (varus coxarthrosis).
- Explosion fractures with large, irreparable bone loss.
- Periprosthetic fractures.

Additional use

- As connection to a pelvic replacement (e.g. acetabulum replacement, internal plevectomy).
- As connection to a total femur.
- As connection to a TUREMOS distal femur.
2. Case examples

Case example /periprothetic fracture
St.G., 1933 m.

1997 cementless hip prosthesis, right.

2/2001 Fall while skiing caused a periprothetic fracture with loosened stem.

2/2001 Revision with cementless TUREMOS expansion stem. Since then capable of doing sports and skiing.

Case example/Klarzell-Chondrosarkom
E.D., 1955 m.

1999 Since 1 ½ years load dependent linguinal pain on the right side.

5/2001 Drilling through the femur from the greater trochanter: Curettage and authologous cancellous bone plastic in another clinic. Unexpected diagnosis for the surgeon. Remaining tumor confirmed.

8/2001 En bloc resection of the proximal femur and cementless implantation of a TUREMOS hip stem. Since then unlimited capability of moving, walking and doing sports. After 8 years no relapse or distant metastasis.

Postoperative function

External rotation
Stretched raising
Active flexion
Squatting position
Abduction
3. Operation planning

3.1 Preconditions

- Native radiograph in 2 levels with ruler (next to the proximal femur on bone level).
- Operational plan with choice of implants.
- Checklist of the implants with part numbers.
- Checklist of the instruments with part numbers.

3.2 Proceeding

- Early scheduling of the operation date.
- Transmission of the X-Rays (with ruler) and diagnosis, initials, dates of birth and gender of the patient (please cover name) by e-mail or internet.
- With these indications the technical and/or medical supporters of Argomedical will assist the surgeon in the planning and the operational proceeding.

A responsible team of Argomedical is prepared to accompany the surgery.

3.3 X-Ray templates

- Prox. femur with head
- Anchor stem
- Tube length 55 mm
- Expansion stem
- Tube length 150 mm
- Extension module
- Tube length 65 mm
4. Instruments

4.1 TUREMOS instruments

Argomedical instruments / TUREMOS tray 1

Argomedical instruments / TUREMOS tray 2

Argomedical instruments / TUREMOS tray 3

Argomedical instruments / TUREMOS tray 4

Generally the TUREMOS instruments are easy to maintain. Their cleaning and sterilization should correspond to the proceedings of the clinic and the general instructions for use and maintenance of the manufacturer.

4.2 Instruments from the clinic

- General bone tray (round hooks, mallet, curette, pestle, flat- and curved chisel of 5 – 20 mm width, flat pliers, pincers, screwdriver, drills of Ø 2 – 6 mm, K-wires Ø 1,5 – 3 mm, etc.).
- Universal drill with AO-connection, chuck and saw adapter, saw blades.
- Short and long rulers.
- Cerclage instrumentation and material (titanium band very suitable).
- HAC granulates (0.5 – 2.0 mm grain size) in reserve.
- Bone cement, only for emergency!
4.3 Dimensions of the lower extremities

4.4 Adjustable resection length
(center of the head to bone resection)

**Prox. femur**

<table>
<thead>
<tr>
<th>Description</th>
<th>Length in 5 mm steps</th>
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<tbody>
<tr>
<td>Prox. femur short L 25 / A 20 Anchor stem HL 55</td>
<td>80 - 100</td>
</tr>
<tr>
<td>Prox. femur standard L 45 / A 20 Anchor stem HL 55</td>
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<td>Prox. femur long L 45 / A 45 Anchor stem HL 80</td>
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<tr>
<td>Prox. femur standard L 45 / A 20 Extension module HL 65 / A 20 Anchor stem HL 55</td>
<td>165 - 205</td>
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<tr>
<td>Prox. femur standard L 45 / A 20 Extension module HL 65 / A 20 Anchor stem HL 80</td>
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<td>Prox. femur short L 25 / A 20 Expansion stem HL 150</td>
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<tr>
<td>Prox. femur long L 45 / A 45 Expansion stem HL 150</td>
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<tr>
<td>Prox. femur short L 25 / A 20 Expansion stem HL 150</td>
<td>240 - 280</td>
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<tr>
<td>Prox. femur standard L 45 / A 20 Expansion module HL 65 / A 20 Expansion stem HL 150</td>
<td>260 - 300</td>
</tr>
<tr>
<td>Prox. femur long L 45 / A 45 Expansion module HL 65 / A 20 Expansion stem HL 150</td>
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<table>
<thead>
<tr>
<th>Total femur description</th>
<th>Length in 5 mm steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prox. femur short L 25 / A 20 Connecting tube short L 205 Dist. femur long L 60 / A 45</td>
<td>290 - 355</td>
</tr>
<tr>
<td>Prox. femur long L 45 / A 45 Connecting tube medium L 255 Dist. femur long L 60 / A 45</td>
<td>310 - 400</td>
</tr>
<tr>
<td>Prox. femur long L 45 / A 45 Connecting tube long L 305 Dist. femur long L 60 / A 45</td>
<td>360 - 450</td>
</tr>
<tr>
<td>Prox. femur long L 45 / A 45 Connecting tube long L 305 Dist. femur long L 60 / A 45</td>
<td>410 - 500</td>
</tr>
</tbody>
</table>

**Explanation:**

- **HL** = Tube length
- **L** = Length
- **A** = Extension

**Remark:**
The first number in the box of the table gives the resection length with fully closed connection. This position should be avoided if possible, because in the repositioned joint, it makes a disassembly later much more difficult.
4.5 Choice of the implant components

Resection length

The minimal length of a proximal resection is 8 cm. Beyond that, down to and including the knee, there are no restrictions. The extension of the different implants is in steps of 5 mm; the rotation remains freely adjustable.

Thanks to this feature the length, which has been planned with the X-Rays and indication, can be adjusted easily intraoperatively according to the findings. (It is therefore often possible to do the operation without time-consuming imaging to secure a R0-resection).

A resection in the lower third of the diaphysis requires the choice of an expansion stem, whose tip can be placed up to 12 cm deep near the fossa intercondylar, about the height of the lateral epikondyle. In case of a longer, respectively deeper resection, the knee joint has to be sacrificed, which results in a total femur replacement (look at TUREMOS dist. femur).

4.6 Assembly and extension possibility

The extensionality of the TUREMOS components is achieved with a taper system. The conical part is introduced into the tube and snapped in one of the grooves. The grooves are placed every 5 mm and as soon as the desired length is reached, the taper is expanded and thus the length secured.
5. Surgical instructions

5.1 Positioning
In supine position with freely movable foil of the hip- and leg region. Disinfection at least down to the knee (Stockinet for the lower leg). Optional foil cover of the surgical field.

5.2 Anesthesia
General or local anesthesia. Considerations: depending on the tumor size and preparation, the surgery can take very long! Antibiosis with Cephalosporin.

5.3 Incision
Lateral skin incision at the proximal femur. Depending on the position of the tumor, the incision has to be extended circular to the spina superioris (tumor in the joint area) and / or distal to medial (tumor medially). Extensions of the incisions are necessary, if additionally an acetabular reconstruction or a total femur must be implanted.

5.4 Access
Longitudinal split of the fascia lata. Detachment of the tendineous structure of the small glutei as close to the periost as possible, the vastus lateralis and medialis from the greater trochanter, iliopsoas and lesser trochanter. Attachment of resected muscular fibers with non-resorbable threads (which will be used later for reattachment). Of advantage is the exarticulation of the femoral head. Under vision sharp detachment and suturing of the external rotators and of the gluteus maximus, always under consideration of possible soft tissue tumor components. If the tumor has contact to the N. ischiadicus or if the blood vessels are covered by tumor medially, a neuro- or micro surgeon can be useful to achieve a R0-resection (neurolysis, vessel transplantation, anastomosis).

Notice:
Orthopedic tumor surgery often requires interdisciplinary cooperation.
5.5 Bone resection

A precise horizontal osteotomy is not necessary because the shoulder of the tube should not lay on the resection. A 0-contact (contact to the resection) must be avoided! Only then the conical shape of the anchor stem can transfer the axial load to the inner cortical wall to its full length (an apositioning does not guaranty a primary load- and rotational stability, the stem can move in the medullary canal).

The spreading stem behaves differently. The apositioning of the tube on the resection is required. Through the spreading of the lamellae the stem is pulled down in the medullary canal.

Tissue sampling from the entrance of the medullary canal for histology and bacteriology is recommended.

After removal of the resected part an additional length measurement for the choice of the components is recommended.

5.6 Intramedullary fixation

- The medullary canal is opened with the conical medullary space drills with AO-connection (tray 1) in progressive steps. Using the drill machine is highly recommended. The machine drilling allows continuous control of the pressure, the resistance and the axial orientation. The medullary space drill is designed for cortical milling. Its tip is only little aggressive, thus avoiding gripping or hooking.

- Evaluation of the medullary canal entrance: if the diameter is 11 mm or bigger, the spiral drills from 10 mm up (tray 1) are being used in ascending order. In case of smaller diameters, the smallest drill from the clinic’s own basic tray is used, until the spiral drill can be applied.

- Often a tight entrance with strong cortical wall is found (thinning out the cortical wall at the entrance can be necessary to ensure later the ideal conical progression of the burr – this does not generate a predetermined breaking point).

- The ideal dimension of the medullary space drill is reached, when at least 2/3 of the length of the longitudinal grooves are filled with bone meal. This is the length which guarantees a circular, cortical contact and therefore secure bone integration.
• The medullary canal is drilled open progressively. It can be necessary to go back to a smaller drill dimension to reach a longer depth.

• **Attention with the final drill!** The last fitting medullary space drill has to exactly reach the level of the medullary canal entrance. In that case, the tightened implant stem will exceed the 0-transition by about 5 mm. If the medullary space drill only lies 1-2 mm deeper, the 0-transition will be reached when tightening the implant. If the medullary space drill lies above entrance level, the shoulder of the implant will stand out by about 1-2 cm.

The primary compression- and rotation stability and the later osteointegration of the implant stem can be enhanced by filling a mixture of bone meal, HAC-granulate and blood into the medullary canal (especially in cases of porotic bones and/or in the larger metaphysis with the expansion stem).

5.7 **Anchor stem**

• According to the last used medullary space drill the selected anchor stem is screwed with the T-wrench (tray 1) into the medullary canal. To make the propelling easier, 1 to 2 reverse turns should be interposed. The firm fit of the implant is reached, when no further turn can be justified for. In case of a correct drilling, the shoulder of the anchor stem can and should not reach the level of the bone resection (avoidance of the 0-transition). A distance of 2-5 mm is desired.

• If the distance is greater than 10 mm, the drilling was not sufficient. After unscrewing the implant, a 2-3 mm longer depth has to be reached with the medullary space drill.

• If there is a risk of a longitudinal cracking while drilling or screwing the stem in (e.g. in case of porotic bone), a cerclage, best with a titanium band, can be applied beneath the bone resection. The tension of the cerclage should not hinder while screwing the stem in place. Only when the implant fits ideally, the cerlage should be tightened firmly.
5.8 Expansion stem

- The drilling depth has to reach at least 12 cm, which corresponds to the length of the implant.
- The preparation of the medullary canal is different for an expansion stem. The drilling occurs cylindrically with the spiral drills (tray 4) to the diameter of 14, 16 or 18 mm. The length of the drilled canal has to exceed 12 cm. The expansion stem has to sit firmly with its shoulder on the resection.
- The expansion stem is driven with the aid of the stud (tray 4) into the medullary canal to the level of the shoulder, keeping the correct axial alignment. Afterwards the expansion of the lamellae is achieved through the central screw in the tube with the T-wrench (tray 2) and then locked in place with a lateral screw.

5.9 Joint assembling

- Preparation and implantation of the acetabular components. In younger patients, a proven, cement-free system should be implanted in the standard way (screw cup or pressfit cup). In case of older patients without implanted cup, a biarticular head can also be used.
- Another length measurement of the extraosseous parts of the stem to determine how deeply the taper of the Prox. femur implant has to be inserted.
- Preparation of the implant Prox. femur: before inserting the taper parts into the tube of the stem, the taper has to fully emerge. This is done by tapping the central screw with the T-hex (tray 2). Only then the insertion into the tube succeeds! With the loose taper the Prox. femur implant is inserted into the desired depth in steps of 5 mm.
When inserting the taper into the tube depth, a clicking occurs, when the tapered part jumps over the grooves. On the desired level, the positioning of the fitting groove can be found through short up-and-down movement. When the taper is fitted in the groove, it is a little more movable. The regulation of the rotation is possible steplessly. The wrench (tray 2) is applied on the side grooves of the implant. It should be held firmly by an assistant, so the central screw can be tightened with the T-hex, until a yawing sound signals the secure clamping.

5.10 Joint repositioning

- When choosing the head, ceramics (especially for younger patients) or cobalt-chromium-heads of size Ø 32 (S, M, L) are favoured. In case of a loose joint a further extension between Prox. femur and anchor stem should be carried out. This additional extension is also possible, with a little skill, when the head is already repositioned. Heads of the length XL and XXL are only used in cases of emergency.

- When using a biarticular head, the size Ø 28 (M) is necessary.

- To position the head on the taper of the Prox. femur a head impactor (tray 2) is used. The same head impactor is used to reposition the head into the socket.

- After repositioning, the joint function is examined. There should be no divergency compared to the preoperative function.

- If, for any reason (wrong positioning, change of length, etc.), the disassembling of the Prox. femur from the tube of the already implanted stem is necessary, the central screw can be loosened with strong counter-clock shocks with the wrench and the T-hex. When tapping the loosened screw in depth, the taper loosens and the Prox. femur part can be turned, adjusted in its length, or pulled out completely. This approach is very helpful in case of possible, later joint revision.

- Generally, neither the Prox. femur, nor the extension module should be sunk completely in the tube of the stems. When calculating the necessary extension, the extensibility of the Prox. femur and of the extension module should also be taken into account. If a luxation should be necessary after joint repositioning or later at a revision, the Prox. femur can be shortened or extended in the tube through loosening the central screw. Necessary luxations, also in case of revisions, become easy.
5.11 Soft tissue reconstruction

- Before the joint repositioning, the fibers of the iliopsoas have to be knotted and the insertion of the gluteus maximus has to be looped with non-absorbable threads. A thread branch is induced behind the implant, the other one is induced in front of the implant to lateral, to be knotted after the repositioning.

- The fibers of the small glutei, which are already looped with non-absorbable threads, are fixated through the holes at the Prox. femur.

- The insertions of the Vastus lateralis and medialis, which are also looped with threads, are quilted to the already fixated insertions of the small glutei.

- Another tissue sampling for bacteriology is recommended.

- After leaving redondrains, the wound closure is carried out in layers.

- Bedding on foam rubber splint.

Comment:

«After 10 years of experience, we don’t consider the fixation of the soft tissue with a stocking-like sheet to the implant to be necessary. About 2 weeks after applying the thread cerclage of the fibers to the implant, a strong circular cicatrificial tissue is already forming, in which, also in case of possible ripping of the threads, the fibers are adhered in their position and keep it. This cicatrization becomes solid, more tenacious and stronger over time. The function of the muscle is fully conserved.»

Dr. M.D. Cserhati.
5.12 Post-operative treatment

- Antibiosis- and antithrombosis prophylaxis according to the clinic’s instruction.

- After the 2nd postoperative day, mobilization from Eulenburg to crutch discharge the operated side (no load over 15kg). Rolling the feet is desired. Toilet on high seat.

- After removing the redondrains, daily 2-3 times Kinetec passive motion with slow increase of the flexion from 20° up.

- In the first 3 weeks rotational movements and isometrics are forbidden. Only from the 5th week on increasing strengthening isometrics and active rotation with passive-active hip mobilization, also with an exercise bike, are allowed.

- After the wound healing, walking baths and later water gymnastics are recommended. Independent swimming after 6 weeks.

- Use crutches with 3-point support during 4 weeks, afterwards 4-point support for another 2 weeks.

- In the 7th week, ambulatory follow-up with radiograph. Thereafter a free build-up workout is possible.

- Depending on the general condition, the treatment should be coordinated with the post operative treatment.
## 6. TUREMOS products prox. femur

### Prox. femur

<table>
<thead>
<tr>
<th>Size</th>
<th>Length</th>
<th>Extension length</th>
<th>Part Nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>25 mm</td>
<td>15 mm</td>
<td>S1524-49K</td>
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<td>Standard</td>
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<tr>
<td>Long</td>
<td>45 mm</td>
<td>45 mm</td>
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### Extension module tube length 65 mm

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### Anchor stem tube length 55 mm

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<th>Ø diameter</th>
<th>Length</th>
<th>Part Nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL 55 mm</td>
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<td>11/14 mm</td>
<td>120 mm</td>
<td>SV0018-11/14K</td>
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<tr>
<td>HL 55 mm</td>
<td>20 mm</td>
<td>13/16 mm</td>
<td>120 mm</td>
<td>SV0018-13/16K</td>
</tr>
<tr>
<td>HL 55 mm</td>
<td>20 mm</td>
<td>15/18 mm</td>
<td>120 mm</td>
<td>SV0018-15/18K</td>
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<tr>
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<td>20 mm</td>
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<tr>
<td>HL 55 mm</td>
<td>20 mm</td>
<td>19/25 mm</td>
<td>120 mm</td>
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### Anchor stem tube length 55 mm cemented

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<th>Length</th>
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<tr>
<td>HL 55 mm</td>
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<td>120 mm</td>
<td>SV0014-10/13/55</td>
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<tr>
<td>HL 55 mm</td>
<td>20 mm</td>
<td>12/15 mm</td>
<td>120 mm</td>
<td>SV0014-12/15/55</td>
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<td>20 mm</td>
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### Anchor stem tube length 80 mm

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<td>45 mm</td>
<td>13/16 mm</td>
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<tr>
<td>HL 80 mm</td>
<td>45 mm</td>
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<td>120 mm</td>
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<td>45 mm</td>
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<td>120 mm</td>
<td>SV0018-11/17L</td>
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### Anchor stem tube length 80 mm cemented

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<tr>
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### Expansion stem tube length 150 mm

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### Connecting tube to total femur

<table>
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<th>Part Nr.</th>
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<td>29 mm</td>
<td>45/45 mm</td>
<td>S20044-29/205</td>
</tr>
<tr>
<td>255 mm</td>
<td>29 mm</td>
<td>45/45 mm</td>
<td>S20044-29/255</td>
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<tr>
<td>305 mm</td>
<td>29 mm</td>
<td>45/45 mm</td>
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