An Overview on Complications of Proximal Femur Tumor Resection and Endoprosthetic Reconstruction

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Abstract:

The proximal femur is a common location for primary malignant and benign lesions as well as metastatic disease. It is the third localization for primary tumors after the distal femur and the proximal tibia and is the main localization for metastasis after the spine. In oncological hip surgery, obtaining a wide margin often means sacrificing important structures such as the joint capsule, the greater trochanter with the insertion of the gluteal muscles and the lesser trochanter with the insertion of the ileo-psoas muscle, with consequent joint instability. The incidence of instability of the hip after proximal femoral arthroplasty (PFA) using an endoprosthesis ranges from 1% to 37% and it is the most common mode of failure in several series. To overcome this problem and make soft tissue reattachment easier artificial band surrounding the implant has been recently introduced aiming to decrease the incidence of instability.

Keywords: Complications, Proximal Femur Tumor Resection, Endoprosthetic Reconstruction.

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Introduction:

Failure of limb salvage surgeries utilizing endoprostheses was initially classified by Wirganowicz as mechanical failure or nonmechanical failure. **(1)** The classification system was extended in 2011 to include 3 mechanical and 2 nonmechanical subcategories of failure. **(2)**

In 2014, the international society of limb salvage (ISOLS) assembled a committee to recommend revision of this classification for its deficiencies and adopted new modified classification including biological and expandable reconstructions. Modifications of endoprosthetic failures classification of the previous system include subcategories of 'a' and 'b' for each failure type (table 1) and addition of type 6 failure which is specific to expandable endoprostheses. **(3)**

• **Type 1 Failures: soft tissue failures.**

They are either functional failure or failure of cover (type 1A and type 1B, respectively). Failure to function results in dysfunction due to instability. This includes joint dislocation or subluxation, excess resection of soft tissues, tendon rupture, and lack of soft tissue ingrowth into prosthetic device. Failure of cover involves aseptic wound dehiscence. It might result in deep infections, thus if the infection occurs as a result of poor soft-tissue cover, the failure would be type 1B. **(3)**

Table 1: Classification of failure of limb salvage after endoprosthetic reconstruction. **(3):**

General category	Mode	Subcategory	Description
Mechanical			
	Type 1 Soft-tissue failure *Dysfunctional or deficient soft tissues resulting in compromised limb function*		
		A Functional	Limited function owing to insufficient musculo-ligamentous attachment
		B Coverage	Aseptic wound dehiscence
	Type 2 Aseptic loosening *Clinical and radiological evidence of peri-prosthetic loosening*		
		A Early	Aseptic loosening < 2 years after implantation
		B Late	Aseptic loosening > 2 years after implantation
	Type 3 Structural failure *Breakage, fracture or wear-related failure resulting in deficient supporting structure*		
		A Implant	Implant breakage or wear; expandable implant lengthening malfunction
		B Bone	Peri-prosthetic osseous fracture
Non-mechanical			
	Type 4 Infection *Infected reconstruction not amenable to retention*		
		A Early	Infected implant < 2 years after implantation
		B Late	Infected implant > 2 years after implantation
	Type 5 Tumour progression *Recurrence or progression of tumour with endoprosthesis contamination*		
		A Soft-tissue	Soft-tissue progression of tumour with endoprosthetic contamination
		B Bone	Bony progression of tumour with endoprosthetic contamination
Paediatric			
	Type 6 Paediatric failures		
		A Physeal arrest	Growth arrest resulting in longitudinal or angular deformity
		B Joint dysplasia	Dysplastic joint resulting from articulation with implant

Instability (type 1A) is the commonest complication of PFR. **(4)** The loss of soft tissue and muscle attachment following tumor resection is the key factor causing instability, but old age, female gender and primary bony tumor can also contribute to dislocation. **(5)**

Dislocation often happens in the first months postoperatively. To decrease the instability risk, significant efforts were undertaken, by hip capsular reconstruction utilizing a synthetic device in which abductors and iliopsoas are reattached. **(6)** Moreover, many studies recommended hemiarthroplasty rather than total hip arthroplasty revealing a significantly decreased dislocation rate of about 67 percent. Long-term acetabular erosion may occur after hemiarthroplasty, but in such patients, shift to THA still could be effectively accomplished. **(7)**

Thus, a bipolar hemiarthroplasty PFR with meticulous soft tissue combination utilizing a synthetic mesh seems to reduce instability and must be done whenever possible. **(5)**

It is not clear whether the utilization of dual mobility cups, which were demonstrated to improve stability in primary and revision THA, might also justify their routine utilization in PFR, though some studies indicated that they may be a choice if bipolar hemiarthroplasty is impossible. **(8)**

- **Type 2 failure: aseptic loosening.**

This is common in PFR and might occur in 0–11%. **(9)** It manifests as osteoclast-induced periprosthetic bone resorption, often because of polyethylene debris that usually presents many years before surgery. Failures that cause aseptic loosening are subclassified as early (< 24 months, type 2A) and late (>24 months, type 2B). **(10)**

In addition, technical issues might have a role as, for example, in the under-sizing of uncemented implant or inappropriate cementing method for cemented implant. **(3)** A surgeon needs to consider different factors including the location in relation to the femoral isthmus, age, bone quality and radiotherapy or chemotherapy as they might interfere with good osseointegration. **(11)**

With modern designs of implants, it seems that a long-term stem fixation could be possible with both modes of fixation, but porous stem, collars or extra-cortical plates might offer more ingrowths and reduce the effect of stress shielding osteolysis. **(11)**

- **Type 3 failure: structural failures.**

These failures are subclassified in accordance to the location of dysfunction. Implant wear or breakage necessitating revision is type 3A, while peri-prosthetic fracture is type 3B. Wear-related exchange of a bushing or other articulating components must be considered as 3A failure even if without reaching the anticipated functional duration. **(3)**

- **Type 4 failure: infections.**

Sarcoma cases are inclined to infections because of wide resections, tissue loss, prolonged surgical time and radiotherapy or use of chemotherapeutic agents. **(12)** A systematic review conducted by Thornley and associates about causes and rates of reoperations following endoprosthetic reconstructions for limb tumor operation, reported that the most accurately reported complication for revision of endoprostheses was in the setting of deep surgical site infection not amenable to implant retention with 9% of cases at a mean of 2 years postoperatively. **(13)**

The most frequently reported causes of amputations following LSS include deep infections as well as local recurrence. Although recurrence risk in some studies has shown to be

reduced over time, the risk of deep infections persists or increases. Deep infection is the current most significant risk for limb survival, though local recurrence can decrease limb survival. **(14)**

Jeys and associates reported reduced rates of treatment of deep infections with local treatments including debridement, arthroscopic washout, and antibiotic agents or antibiotic-laden beads or cement. Twostage revision was the best limb-salvage technique for control of these infections. Limb-salvage technique includes removal of the prosthesis and insertion of an antibiotic impregnated cement spacer, which remains in place for at least 6 weeks. The next stage is carried out only if there is negative culture of peri-prosthetic aspirate. **(12)**

- **Type 5 failure: recurrence.**

Due to potential differences in treatments and prognosis, failures of limb salvage because of recurrence of tumor due to contamination at the time of reconstruction have been considered as soft-tissue recurrence (type 5A) and bony recurrence (type 5B). Both types require prosthetic removal, however recurrence in the soft tissues might be managed by prosthetic removal, wide local excision, and adjuvant therapy without additional bone resection. On the other hand, recurrence within the bone requires resection of further native bone, necessitating a total bone prosthesis or even amputation. **(3).**

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