Periprosthetic Femoral Fractures

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Abstract

Fracture of the femoral shaft around a hip prosthesis presents the simultaneous problems of prosthetic stability and femoral- fracture management. Treatment options include nonoperative stabilization (traction) and operative stabilization by means of intramedullary fixation, extramedullary fixation, or proximal femoral prosthetic replacement.

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The difficulty of managing femoral fractures is complicated by the presence of a femoral prosthetic component. This review of periprosthetic fractures is divided into three parts: classification, etiology and prevention, and treatment. Classification is according to a simple anatomic description of the fracture. Prevention of fractures depends on identification and management of predisposing risk factors. Treatment is directed at both fracture union and prosthetic stability.

Classification

Classifying periprosthetic femoral fractures has proved to be quite difficult. Each of the three basic regions--proximal, middle, and distal-- addressed by the various classification systems has its own unique characteristics. This is complicated by the possibility of overlap between regions. Subsequent treatment must take into account the fracture pattern, prosthetic stability, and the type of prosthetic fixation involved. Most classification systems describe fracture patterns but fail to address prosthetic stability[1-7] (Table 1). As a result, the numeric and alphabetic systems may not represent the various potential problems encountered as effectively as is possible with a simple description, such as will be used in this article.

Proximal Region

Proximal periprosthetic fractures are usually longitudinal splits that occur intraoperatively when bone is being prepared or an uncemented component is being placed within the canal.[6,8] They are divided into stable and unstable patterns (Fig. 1).[2,6] Stable patterns do not require further augmentation or fixation to maintain prosthetic or fracture position. Longitudinal splits proximal to the lesser trochanter are considered stable fractures provided a collared prosthesis is used.[2,6,8] An unstable fracture pattern is a complete two-part fracture.[6] Unstable fractures require specific interventions to maintain prosthetic and fracture stability.[6]

Middle Region

Middle-region periprosthetic fractures have a high association with prosthetic loosening.[4,7] Bethea et al[4] noted a 50% subsequent revision rate for middle-region fractures initially treated nonoperatively. These fractures usually occur in the postoperative period, often around a loose prosthesis.[4]

Middle-region fractures occur between the lesser trochanter and the prosthetic tip. Since the fracture is proximal to the prosthetic tip, in some cases the stem may remain within the distal canal and provide fracture stability.[3,5,7]

Middle-region fractures have generally been divided into two types: noncomminuted (spiral or oblique) and comminuted (Fig. 2).[2,4] Noncomminuted fractures are inherently more stable.[3] Increased comminution in this region jeopardizes both prosthetic and fracture stability.[7] Comminuted fractures are rarely localized to just the middle region.

Distal Region

Distal periprosthetic fractures are associated with high rates of nonunion but low rates of prosthetic loosening.[3,4,9] When treated nonoperatively, distal fractures have nonunion rates ranging from 25% to 42%.[3,4,9] They have been divided into

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Table 1
Periprosthetic-Fracture Classification Systems

Fracture Description	Classification System					
	AAOS[2]	Johansson[3]	Bethea[4]	Serocki[5]	Schwartz[6]	Cooke[7]
Proximal region						
Stable (proximal split)	Type II	...	...	...	Incomplete	...
Unstable (two-part)	...	...	...	...	Complete	...
Middle region						
Noncomminuted	...	Type I*	Type B	Type I*	...	Type 2*
Comminuted	Type V	...	Type C	Type IV	...	Type 1
Distal region						
At level of stem tip	Type IVb	Type II*	Type A	Type II†	...	Type 3
Below stem tip	Type VI	Type III	...	Type III	...	Type 4
Two or more regions						
Proximal and middle	Type III	...	...	...	Complete	...
Middle and distal	Types IVa, V	Type II†	Type C	Type II	...	Type 1

* Stem tip still in distal intramedullary canal.
† Stem tip not in distal intramedullary canal.

two types: fractures at the prosthetic tip and fractures distal to the tip (Fig. 3).[2,3,5,7] In fractures far below the stem tip, the fracture usually can be treated independent of the prosthesis.[10]

Distal fractures usually occur postoperatively below well-fixed components,[3] but can also occur intraoperatively when a straight-stem uncemented component impacts on the anterior femoral bow.[6,8] These intraoperative impaction fractures can result in a completely displaced (two-part) oblique fracture or an incomplete fracture.[6] Incomplete fractures can be either small fissures or complete perforations (full cortical defects) with the prosthetic tip outside the intramedullary canal. Incomplete fractures at the stem tip create stress risers that predispose the patient to postoperative completion of the fracture.

Combinations

Intraoperative and postoperative fractures that span more than one region of anatomic involvement (Fig. 4) are obviously more difficult to manage. When an intraoperative longitudinal split extends past the proximal region into the middle region, prosthetic stability is jeopardized.[8]

Postoperative fractures involving the middle and distal regions are associated with high rates of both nonunion and prosthetic loosening. The fracture pattern can vary from minimal to severe comminution.

Etiology and Prevention

The most important factors in preventing periprosthetic femoral fractures are identification and management of predisposing factors.[1,10] These factors vary for intraoperative fractures and postoperative fractures. Decreased bone strength can lead to an increased risk for both intraoperative and postoperative fractures.[1] Bone strength can be decreased secondary to osteoporosis and metabolic bone diseases. Treatable conditions such as osteomalacia must be recognized and addressed.

Intraoperative Fractures

Intraoperative fractures occur in 3.5% of primary uncemented hip replacements[8] and in 0.4% of cemented arthroplasties.[3] Fractures can occur during bone preparation, prosthetic insertion, or surgical exposure.[1,6,8,10]

Proximal fractures usually occur with bone preparation (aggressive rasping) and prosthetic insertion; fractures associated with prosthetic insertion are most frequently seen with uncemented arthroplasty.[1,6,8] Proximal fracture during insertion of the prosthesis is usually the result of mismatching of the dimensions of the prosthesis and the bone.[6,8] Prophylactic wire cerclage of the proximal femur should be considered in patients who have had previous internal fixation or who have poor bone stock.[8]

Middle-region fractures most commonly occur when excessive torque is applied to the femur during surgical exposure or bone preparation. Fractures during bone preparation can be due to torque generated by power reamers. Risk factors during surgical exposure include weak bone, protrusio acetabuli, soft-tissue contractures, and bone defects from previous surgery.[1,10] It is advisable to leave plates and screws from previous surgery in place until after dislocation of the hip because the unfilled bone holes act as stress risers, weakening and predisposing the bone to fracture during the dislocation maneuver.[1,10] One should consider

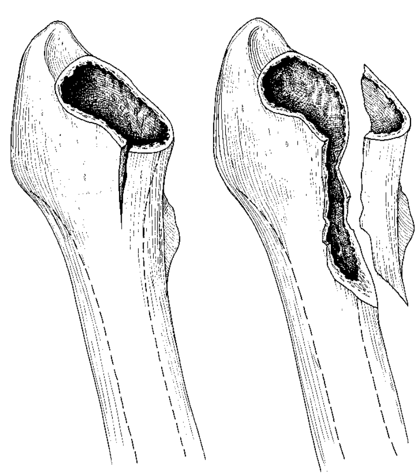

Fig. 1: Stable **(left)** and unstable **(right)** proximal-region periprosthetic fractures

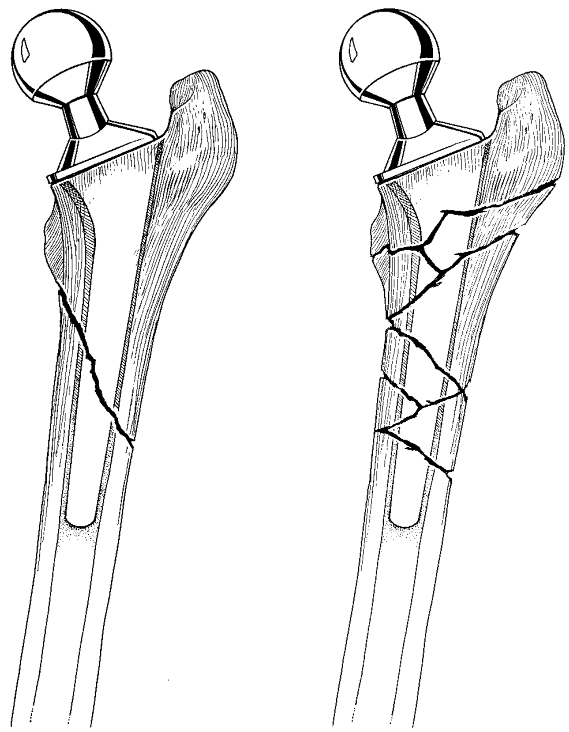

Fig. 2 Noncomminuted **(left)** and comminuted **(right)** middle-region periprosthetic fractures.

cutting the femoral neck before dislocation of the hip in patients with weak bone stock, significant contractures, or protrusio acetabuli.[10] In the setting of protrusio acetabuli, trochanteric osteotomy should also be considered to provide better exposure prior to dislocation.[1]

Distal fractures can occur when the tip of a straight-stem prosthesis impacts on the curve of the femur.[6] Preoperative templating may reduce the risk of fracture during bone preparation and prosthetic insertion.[6,8] Normal anatomic variations and bone deformity must be taken into consideration.[8] Thought should be given to the curve of the proximal femur when choosing a prosthetic system.[8]

Postoperative Fractures

In postoperative fractures, trauma is often minor, and the fracture is secondary to stress risers resulting from bone defects or weak bone stock.[1,3] The incidence of postoperative periprosthetic fractures is approximately 0.1%.[1]

Proximal fractures are rare in the postoperative period and are usually extensions of previously unrecognized intraoperative fractures. Middle-region fractures usually occur around a loose prosthesis.[4] Bone deficiency is often created by bone lysis about loose prostheses, but can occur as a reaction to wear debris around well-fixed prostheses. Early intervention with impending fractures reduces the risk of fracture and makes the revision easier.

Middle- and distal-region periprosthetic fractures can be secondary to bone defects produced iatrogenically during procedures performed before total joint arthroplasty.[1,8,10] The region in which the defects are present will be most at risk for fracture. Defects can be created during cement removal in revision cases or can occur around old screw holes after failed fracture treatment.[1,8,10]

Stress risers need to be recognized at the time of surgery and treated with bone grafting.[1,3,5,10] It is advisable to consider postoperative protection, bracing, and partial weight-bearing while bone grafts are incorporating.[1] The femoral stem should extend beyond full cortical defects (e.g., screw holes and larger defects) by a distance equal to twice the bone diameter.[1,3]

Management

Goals

The two goals of periprosthetic fracture treatment are to obtain near-anatomic fracture union and to maintain or obtain a functional prosthesis.[3] Fracture treatment choices are based on an understanding of factors influencing these goals and the fracture pattern.

Fracture Union

Fracture stability and bone quality affect the rate of fracture union. The location of the fracture affects stability, and previous surgery affects bone quality.

Fracture stability varies with the region involved. Proximal-region fractures are usually incomplete longitudinal splits and are stable provided a collared prosthesis is used.[6] Middle-region fractures have high union rates, ranging from 80% to 100% depending on the amount of comminution, regardless of treatment type.[3,4,7] This has been attributed to the increased fracture stability when the stem remains in the distal canal.[3] Distal-region fractures are associated with significant fracture instability, resulting in a high incidence of nonunion (25% to 42%) with nonoperative methods.[4,10] Union rates with distal fractures improve dramatically with surgical stabilization (90% to 100%).[5,7,9]

Poor bone stock contributes to nonunion.[4] Bone quality can be compromised by multiple previous surg-

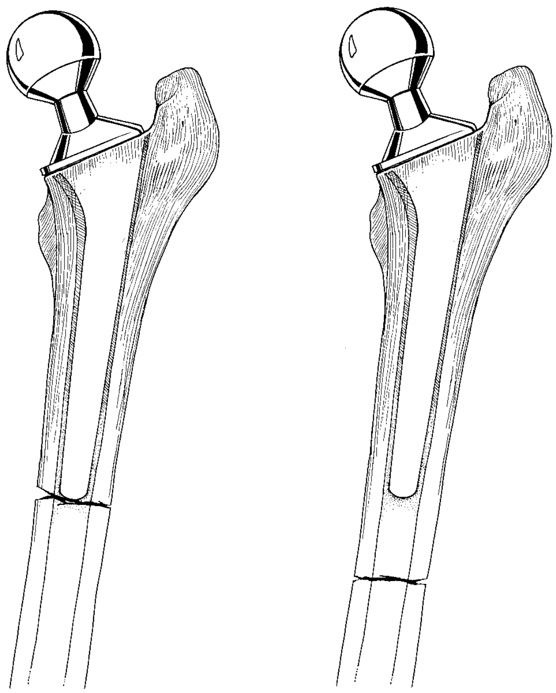

Fig. 3 Distal-region periprosthetic fractures at the level of the stem tip **(left)** and distal to the stem tip **(right)**.

eries, resulting in generalized loss, localized defects, and devascularization. Stress risers from localized bone defects are often the cause of fractures; if not recognized and treated with bone grafting, they can predispose the patient to yet another fracture.[1,3] Most authors recommend bone grafting defects as a routine when the fracture is managed surgically,[1,3,5,10] and some recommend regrafting if there is no evidence of radiographic healing by 3 months.[10] Interposition of cement between healing fracture fragments can contribute to the persistence of bone defects,[5] but fracture healing can still occur.[4,11] Devitalized bone from disruption of both the endosteal and the periosteal blood supply has a major adverse effect on bone healing.[3]

Prosthetic Function

Two prosthetic function issues should be clarified prior to fracture treatment: Was the prosthesis functioning satisfactorily before the fracture? Will the fracture compromise prosthetic fixation?

Assessment of prefracture function requires information regarding prosthetic type, clinical function, and prefracture radiographic evaluation. Prosthetic type is important for two reasons. First, in the case of a prosthesis with a high rate of component failure, the surgeon might consider revision even if the prosthesis is well fixed (e.g., a nonmodular titanium head). Second, knowledge of prosthetic fixation will be important in determining prosthetic stability.

Prefracture clinical function needs to be assessed with regard to the presence of disabling activity pain, rest pain, weakness, limitation of ambulatory distances, and need for assistive devices. Evaluation of clinical function level may rely heavily on the history if the patient had been followed up before the fracture by another physician. If the patient had a poorly functioning prosthesis before the fracture, preservation of the prosthesis is less reasonable.[4,7]

Correlation should be made between the prefracture clinical function and the radiographic findings. Bethea et al[4] noted evi-

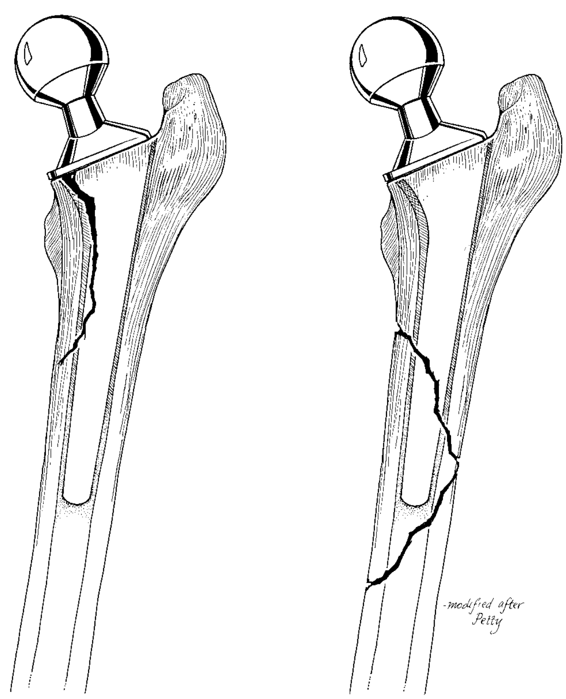

Fig. 4 Combination periprosthetic fractures of the proximal and middle **(left)** and middle and distal **(right)** regions.

dence of loosening in 75% of the prefracture radiographs they studied. Femoral problems that should be assessed include bone-cement radiolucent lines, osteolysis, component migration, cement fracture, and femoral component fracture.

Revision of the entire hip arthroplasty should be considered if the acetabular component has failed. Acetabular problems that should be assessed include acetabular bone-cement radiolucent lines, severe polyethylene wear, and component migration. If hemiarthroplasty was performed, acetabular erosion should be evaluated.

Prosthetic failure can be secondary to infection, aseptic loosening, prosthetic fracture, or severe acetabular wear. If there was clinical or radiographic evidence of failure of the prosthesis before the fracture, revision with a long-stem femoral component should be performed.[7]

When assessing the effect of the fracture on prosthetic fixation, one must take into consideration both the fracture type and the type of prosthesis. Proximal intraoperative fractures occurring around a collared uncemented component will not affect prosthetic fixation when there is a stable fracture pattern.[6] Failure to recognize and address unstable proximal fracture patterns at the time of surgery can lead to prosthetic instability.[6,8] With longitudinal fracture patterns, a collarless uncemented prosthesis can continue to settle, propagating the fracture and leading to an unstable fracture pattern. Accordingly, a collared prosthesis is desirable in this circumstance.

Prosthetic loosening occurs more frequently (in 50% to 100% of cases) with middle-region periprosthetic fractures, especially those with comminution.[3,4,7] Fractures distal to the prosthesis have a minimal effect on prosthetic fixation.[7] Fractures distal to a well-fixed prosthetic ingrowth area can be treated like distal fractures (Fig. 5,A), even with involvement of the middle region.

A similar approach is used to assess fracture involvement of prosthetic fixation for fully coated uncemented and cemented prostheses. The cement-prosthetic construct, however, is more vulnerable to permanent damage.

Management of Intraoperative Fractures

Intraoperative fractures are often not recognized until the postoperative period.[6] Therefore, the surgeon should maintain a high level of suspicion when encountering insertion difficulties.[6]

Intraoperative fractures occur more frequently with uncemented arthroplasty. Proximal longitudinal splits that propagate only to the lesser trochanter often do not require treatment if a collared prosthesis is used.[6] Unstable intraoperative fractures should be stabilized surgically with cerclage fixation[6,8] and a collared prosthesis. Fractures that propagate into the middle region may require a longer prosthetic stem.[6]

Complete (transverse, two-part) fractures of the middle or distal region should be treated with open reduction and internal fixation with the use of either a longer stem or plate fixation.[6]

Distal incomplete fractures can range from small fissures to stem perforations.[6] Small fissures do not require additional surgical treatment.[6] Perforations by the stem tip, if recognized intraoperatively, should be treated with bone grafting and

A B C

Fig. 5 Images of a 42-year-old hemophiliac patient with a dysplastic hip who had undergone noncemented total hip arthroplasty 6 months earlier because of severe pain. **A,** Severe trauma to the leg resulted in a combination middle- and distal-region fracture that did not involve the proximal porous coating of the prosthesis. **B,** Postoperative anteroposterior radiograph shows fixation with modified plate for screw-and-cerclage fixation. Note that there is room for only one proximal screw in the intertrochanteric region. **C,** Frog-leg lateral radiograph obtained 6 months after open reduction and internal fixation (1 year after total hip arthroplasty) shows evidence of fracture healing. Full weight-bearing without pain was possible.

use of a longer stem bypassing the defect. When a perforation is not recognized intraoperatively, postoperative management will need to be individualized on the basis of the surgeon's assessment of prosthetic stability and the risk of fracture.

With cemented arthroplasty, unrecognized intraoperative fractures can result in cement extravasation and potentially interfere with bone healing.[5] When the fracture is recognized and reduced, extravasation can be minimized, and the cement can impart additional fracture stability.[11] Unrecognized cement extravasation, like stem perforations, will put the patient at risk for femoral fracture; however, if the patient is clinically asymptomatic, immediate revision may not be necessary.

Management of Postoperative Fractures

Postoperative periprosthetic fractures can be treated either nonoperatively or operatively.

Nonoperative Treatment

Nonoperative treatment of postoperative periprosthetic fractures is reasonable if (1) surgical stabilization would compromise bone stock or prosthetic stability[10]; (2) alignment can be obtained and maintained with traction or casting;[1,3,7,10] (3) the patient would not tolerate surgery; (4) the prosthesis is not loose and is unlikely to become loose[4,7]; (5) a proximal longitudinal split with an uncemented prosthesis occurred in the early postoperative period (often an unrecognized extension of an intraoperative fracture)[6]; or (6) the fracture is in the middle region, and the prosthesis provides adequate fracture stability.[3,10]

Although the last-mentioned situation is a frequently cited indication for nonoperative management, there is little clinical evidence that the fracture stability provided by the prosthesis is significant. Johansson et al[3] originally described this fracture pattern, but reported the cases of only two patients treated nonoperatively in this setting; both healed with a loose prosthesis that required revision.

Nonoperative management ranges from protected weight-bearing to skeletal traction. It is individualized on the basis of prosthetic stability, fracture stability, and the physical status of the patient. Generally, nonoperative management involves traction for 4 to 8 weeks, followed by cast bracing until the fracture has healed.

Complications with nonoperative management, in addition to the problems associated with extended bed rest, are frequent. The subsequent revision rate for middle-region periprosthetic fractures is 50% to 100%.[3,4] The nonunion rates for fractures at the prosthetic tip are in the range of 25% to 42%.[3,4]

Operative Treatment

With or without hip prostheses, patients with femoral fractures do better when the fracture can be fixed securely enough for patient mobilization. Surgical management is most clearly indicated when (1) the prosthesis is loose or fractured;[4,7] (2) the patient is a poor candidate for bed rest; (3) there is poor alignment of the fracture such that malunion will occur (making future surgery difficult); (4) the fracture is distal, at the level of the stem tip[9]; or (5) fixation can be accomplished without compromising either prosthetic fixation or bone stock.

Surgical options include intramedullary fixation, extramedullary fixation, and revision to a proximal femoral replacement. Some cases require a combination of intramedullary and extramedullary fixation.

The type of surgical fixation required depends on the region involved and whether the prosthesis is loose. Proximal-region fractures without middle-region involvement were discussed in the section on nonoperative treatment, since they rarely require further surgery. Middle-region prosthetic fractures with an associated loose prosthesis require long-stem prosthetic revision as a means of obtaining intramedullary fixation. With distal-region fractures, prosthetic stability is not in jeopardy; therefore, prosthetic retention and open reduction and internal extramedullary fixation (plates, screws, and cerclage fixation) should be considered.

There are two types of intramedullary fixation, nonprosthetic and prosthetic. Nonprosthetic fixation usually involves an intramedullary rod that overlaps with the prosthesis. Prosthetic fixation involves use of a long-stem femoral component as an intramedullary rod.

Nonprosthetic intramedullary fixation works best with an implant that does not fill the intramedullary canal, such as an Austin Moore prosthesis. Intramedullary fixation has been described using Ender rods, Zickle supracondylar rods, and Kuntscher rods. For most contemporary femoral implants, this approach is not possible because the canal is entirely filled by the prosthetic construct. In these situations, intramedullary fixation can be achieved only with revision to a long-stem femoral component, which acts as an intramedullary rod. Occasionally in fractures far enough distal to the stem tip, a short interlocking intramedullary nail can be inserted retrograde to remain completely distal to the prosthesis.

Prosthetic intramedullary fixation is most commonly used for fractures in the middle region when the prosthesis is loose.[3-5,7,9,10,12,13] This option may be used when the prosthesis is in jeopardy or has failed for reasons other than loosening. When a long-stem prosthesis is used as an intramedullary rod, the combined nonunion, refracture, and revision rates are in the range of 12% to 20%.[7,13]

Noncemented prosthetic revision is more often performed in young patients,[10] while cemented revision is reserved for older patients with adequate bone stock.[7] The order of priority during the operation is fracture reduction, good cement technique, and bone grafting.[4,7] It is recommended that the fracture be bypassed by at least twice the bone diameter.[1] Bone grafting should be performed with morcellized bone and / or cortical-strut allografts.

Fracture stability is a high priority. In selected cases, a modular prosthesis may provide better fracture and prosthetic stability than an off-the-shelf prosthesis. The short-term benefits of maximizing prosthetic fit with modular components must be weighed against the potential disadvantages of fretting and disassembly.

Extramedullary augmentation of prosthetic intramedullary fixation has a potential role in the uncemented setting. There is less need for augmentation with cemented prostheses because the cement contributes to stability.

Extramedullary fixation is best reserved for distal fractures that have well-fixed femoral components. Extramedullary fixation involves the use of some type of longitudinal support (plate[5,9] or cortical-strut allograft[14]) fixed with screws[5] and / or cerclage devices.[9]

Plate-and-screw fixation with a standard AO broad plate has yielded excellent results in the patient with a well-fixed prosthesis.[5] There has been no clinical evidence of loosening of a cemented prosthesis resulting from violation of the cement mantel by screw fixation[5,7]; however, this is a theoretical risk that may deter surgeons from using screw fixation alone.[9] To avoid this risk, specialized plates have been developed to accommodate fixation with screws and cerclage (Parham bands with Ogden plate, Dall-Miles cable and plate).[9] These modified plates should be used when screw fixation alone is not possible due to complete filling of the intramedullary canal by an ingrowth prosthesis (Fig. 5).

The reported union rates for plate-and-screw fixation and fixation with modified plates and cerclage range from 90% to 100%.[5,7,9] However, complication rates as high as 80% have been reported.[13] Complications include fractures below the plate,[9,13] nonunion,[5] and component loosening.[5] Modified plates are not necessary when the fracture is well below the prosthetic tip.

Cerclage fixation by itself has been shown to be a poor option.[12] Cerclage fixation should be used only to augment longitudinal fixation with either extramedullary or intramedullary fixation.[12] Partridge and Evans[12] reported a 70% union rate with cerclage alone and a 100% union rate when cerclage was used with longitudinal support (either extramedullary or intramedullary). In the treatment of intraoperative proximal longitudinal splits,[6,8] cerclage is used to augment the intramedullary longitudinal support from the femoral component. Although cerclage fixation has been criticized because of cortical erosion[5] and adverse effects on the cortical blood supply,[12] clinically it has proved to be effective fixation for periprosthetic fractures and has not been found detrimental to fracture healing.[9,12]

One specific form of extramedullary longitudinal support, cortical- strut allografting, relies on cerclage fixation.[14] In this situation, the allograft is used as a biologic plate.[14] There is very little in the literature regarding the strength of fixation obtained with periprosthetic fractures. Cortical strut grafts can be used to augment long-stem prosthetic revisions without sacrificing the load-sharing benefits of an intramedullary device.

Revision to a proximal femoral replacement should be reserved for a fracture around a loose prosthesis in an elderly patient with unreconstructable proximal bone stock.[7] In the younger patient, consideration should be given to a proximal femoral allograft. Success rates for these uncommon salvage operations are not known.

Special Problems

Fractures and Septic Loosening

Infections associated with periprosthetic fractures are reported to occur in as many as 16% of patients.[4] Bethea et al[4] discussed the treatment of this complication in five of their patients. In the one case in which infection (Bacteroides) was identified preoperatively, the patient underwent resection arthroplasty and 2 weeks of traction, followed by revision with a long stem. The other four patients underwent revision to a long-stem prosthesis. The intraoperative cultures in those four cases were positive (a-streptococci in two, *Staphylococcus epidermidis* and mixed flora in one case each). All five patients subsequently healed with suppression of the infection.

As with infected femoral fractures without prostheses, the first goal of management is fracture stabilization.[4] Since an infected nonunion poses even greater difficulty in management, it may be necessary to compromise the traditional protocols for prosthetic infections to achieve the primary goal of fracture stability and union. In managing infections associated with periprosthetic fractures, the priority should be removal of the loose prosthesis and debridement of all necrotic or infected tissue, followed by fracture stabilization.

The experience of Bethea et al[4] supports stabilization with long-stem femoral revision. Whether implantation of the new prosthesis should be delayed or uncemented has not been well addressed by the clinical studies performed to date.

Middle-Region Periprosthetic Fractures Around Well-Fixed Components

Can a prosthesis remain stable when the bone around it is fractured? It is difficult to draw conclusions from the literature since there have been so few cases in the studies reported and pretreatment prosthetic stability has been infrequently discussed.

This problem is rarely discussed separately. Fracture around previously well-fixed cemented prostheses will disrupt the bone-cement interface or fracture the cement, which by some definitions creates a loose prosthesis.[7] Others, including Charnley,[11] have noted that fresh fractures through bone containing a cemented prosthesis can heal.

All arguments regarding the treatment of middle-region fractures around stable components have been based on anecdotal experiences. Three treatment modalities have been advocated: nonoperative treatment, open reduction and internal fixation with a plate, and long-stem revision.[3-5,9,12,13]

Nonoperative treatment has been recommended for noncomminuted fractures in which the prosthesis provides fracture stability.[3] While healing rates approach 100%, subsequent loosening rates with middle-region fractures range from 50% to 100%.[3,4,13]

Other authors have recommended surgical management, especially when there is comminution.[4,5,7] Controversy exists as to whether plate fixation[5] or long-stem revision[4,7] is the best option. In 15 middle- region periprosthetic fractures revised to a long-stem component, Cooke and Newman[7] found infections in 2 and loosening in 3 (average follow-up, 3.6 years).

It has been suggested that, despite the risk of later prosthetic loosening, the initial surgical treatment should be open reduction and internal fixation using plate-and-screw fixation followed by later revision, if needed.[5] Nonunion and refracture rates with plate fixation range from 10% to 80%.[5,9,13] Serocki et al[5] reported on a group of 10 patients with fractures in the middle and distal regions treated with plate-and-screw fixation. One patient underwent revision to a long-stem component because of plate failure and nonunion. The fractures united in the other 9 patients; however, 2 patients with previously loose prostheses subsequently required revision. None of the preoperatively well-fixed prostheses loosened postoperatively.[5]

Middle-region periprosthetic fractures have different ramifications for partially coated uncemented prostheses than for fully coated prostheses (and cemented prostheses). When the fracture occurs outside the region of prosthesis-bone fixation (below the proximal coating of the uncemented device), it should be treated as a distal fracture, and the prosthesis should be left in place (Fig. 5, A).

In general, the more the prosthesis is at risk for failure (comminution), the greater the indication for revision rather than internal fixation. However, each case must be individualized, weighing the risk of future surgery against the risks of current treatment alternatives. It is in this type of situation that a surgeon's experience plays a significant role. Furthermore, a well-thought-out surgical plan may be altered by the operative findings. A prosthesis thought to be loose may be firmly fixed, and vice versa. Thus, the surgeon should be prepared for more than one surgical option depending on the intraoperative findings.[3]

Summary

It is possible to describe periprosthetic fractures with a simple classification system as effectively as with the many more sophisticated systems. The description should include reference to prosthetic fixation, fracture pattern, and the region involved. Each region has unique characteristics.

Proximal intraoperative splitting fractures are stable, but splits propagating below the lesser trochanter and two-part fractures are potentially unstable. Unstable fracture patterns are usually amenable to cerclage fixation with a collared prosthesis and, in some cases, a longer stem.

With middle-region periprosthetic fractures, prosthetic fixation is at risk. A previously loose prosthesis should be revised in conjunction with fracture management. With a well-fixed prosthesis, if the risk of future loosening is high, revision should be considered rather than internal fixation or nonoperative management. Each case must be individualized, and the surgeon's experience plays a significant role in the decision-making process.

Extramedullary fixation is more often reserved for a stable prosthesis, usually encountered with distal fractures. Modified plates that use a combination of screws and cerclage fixation should be considered with fractures at the prosthetic tip, especially when there is little room available for screws to bypass the prosthesis. Fractures distal to the tip can be treated independent of the prosthesis with a standard AO plate.

The surgeon should be prepared for more than one surgical option prior to operative intervention.[3] The overriding goal remains the same for all fractures: anatomic union of the femoral fracture while maintaining or obtaining a well-fixed functioning prosthesis.

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