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Case Report

Braided Polyester Suture Fatigue Failure When Treating Transverse Patellar Fracture: A Case Report

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Patellar fractures account for 1% of all skeletal fractures and frequently require surgical intervention. Recently, non-absorbable polyester sutures have been advocated as good substitutes for stainless steel wire in certain fracture fixations, including patellar and olecranon fractures. They are said to be strong and have some advantages over conventional stainless steel wire. However, limited study scale and even experiences required in manipulation make it controversial to routinely use this relatively new method for fracture fixation. There are few reports describing complications with their use. Herein, we report a case of failed fixation using Ethibond sutures in a transverse patellar fracture. The sutures failed to sustain the repetitive loads of daily activities because of too few loops and inadequate knotting. Considering a stable and secure construct is prerequisite to bony union, surgeons should be knowledgeable of mechanical properties of these materials they use and the corresponding surgical techniques needed to avoid later fixation failure.

Keywords: patellar fracture, non-absorbable polyester, fixation, failure, Ethibond suture

Introduction

The incidence of patellar fractures accounts for almost 1% of all skeletal fractures[1]. In case of a displaced patellar fracture, surgical intervention is often advocated for earlier stability, restoration of knee motion, and shortened morbidity[2-3]. Among various fixations, the AO modified tension band technique, which incorporates two parallel Kirschner wires with an anterior tension band, is the most widely applied method[3].

In current practice, the stainless steel wire is the material of choice for treatment of these fractures because of its high tensile strength. However, certain concerns about the difficult manipulation of the wire, frequent irritation after implantation, and even later relieving removal prompted investigators to seek alternatives. Some surgeons began using a braided polyester suture as substitute for stainless steel because it evokes minimal tissue reactivity [4] and works as well mechanically as the stainless steel wire[5].

In the literature, failure of non-absorbable suture fixation is seldom reported. In 2001, Gosal et al, reporting their experience using nonmetallic

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sutures to fix 16 patellar fractures, described one failure, which at re-operation was found to be caused an undone knot[6]. Herein, we report a case of failed suture fixation of patellar fracture. A different mechanism from the mentioned one is indicated by the retrieved sutures. With a brief review of literature, possible causes of failure were discussed.

Case Report

A 56-year-old woman had a patellar fracture caused by an impact injury. She was treated at a regional hospital where her transverse patellar fracture was operatively fixed with non-absorbable braided polyester suture, No.5 Ethibond (Ethicon, Inc). According to her, early postoperative course was relatively smooth, and one week later, she was allowed ambulate with partial weight bearing with the support of a knee brace and crutches. Rehabilitation to restore ordinary knee motion proceeded gradually with active or passive bending. However, around 6 weeks after surgery, she noticed a palpable gap around the fracture site. Because of an increasing gap, she came to our outpatient clinic for further evaluation. On physical examination, a palpable depression on her left knee cap and functional impairment of the extensor mechanism were noted. Radiographs showed a wide transverse patellar cleavage between displaced fragments, indicating that the fixation she received previously had failed (Fig. 1). After a discussion of treatment options, the patient agreed to have a surgical revision to restore functionality.

During revision, we found no adjuvant longitudinal Kirschner wire, only two loose No.5 Ethibond suture loops. These 2-loop sutures were used to form one superficial tension band and a circumferential ring. We found several tear-induced disruptions around the superficial fracture site and bony corners (Fig. 2). After the nonmetallic sutures were removed, we fixed the reduced patellar fracture with two longitudinal 4.0-mm cannulated screws and used 18-gauge stainless steel wire to create a modified anterior tension band and an augmentative circumferential loop (Fig. 3). After surgery, the patient made an uneventful recovery and regained her knee functions quickly.

Discussion

The use of stainless steel wire in certain fractures under dynamic tensile distractive forces, such as patellar and olecranon fractures, is frequently associated with clinical discomfort. Over the past decade, several papers have

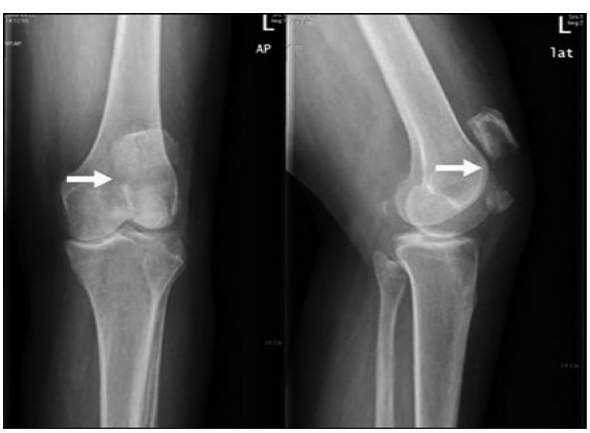

Fig. 1 Radiography of the left knee (AP and Lateral views) obtained six weeks after the index procedure shows a wide transverse cleavage as well as displacement of fragments, indicating the failure of prior internal fixation.

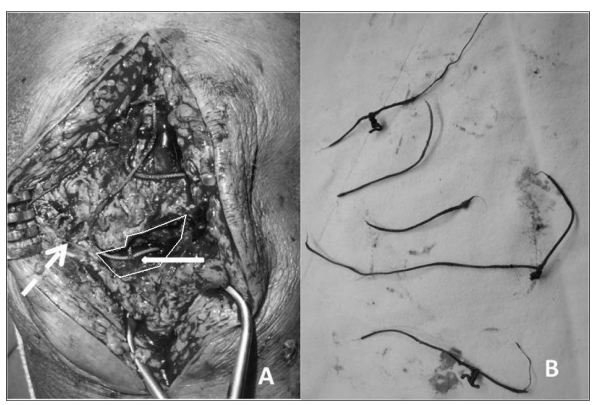

Fig. 2 Intraoperative photography (2A) demonstrates the findings of the pre-operative radiography. Note the increased interfragment gap without bony growth (arrow) and the loosened fixation loops by disruption of Ethibond suture (dashed arrow). Besides, no adjuvant longitudinal Kirschner wires or screws were found. Photo of the retrieved sutures (2B) showing several tear-induced disruptions along the suture, reflecting repetitive loading failure.

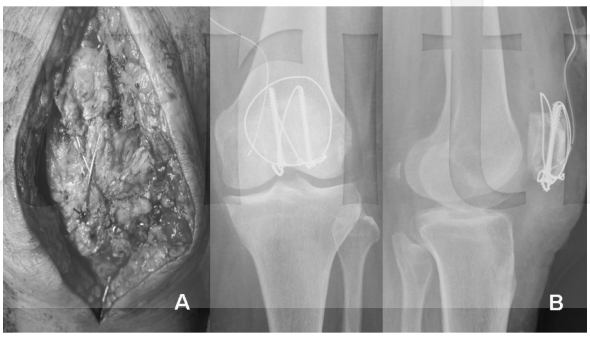

Fig. 3 After revision, the fragments were fixed with two longitudinal 4.0-mm cannulated screws and a modified anterior tension band loop using 18-gauge stainless steel wire. Another circumferential wire loop fixation was added for augmentation.

advocated substituting the wire with strong nonmetallic materials such as the braided polyester. In 1998, Chatakondu et al. reported their preliminary experiences using the Pyrford technique with non-absorbable sutures for patellar fixation in seven patients; fractures were united and pain-free knee function was restored in all seven cases[7]. In 2001, Gosal et al., comparing different fixation materials, concluded that stainless steel wire was associated with a higher risk of infection than No.5 non-absorbable polyester[6]. In that study, they also mentioned encountering a failed fixation in a comminuted patellar fracture fixed with nonmetallic sutures, which they revised using standard steel wire.

Patel et al. used cadaveric knee specimens to demonstrate that the strength of fixation (fracture gap formation > 3mm) by braided polyester suture could compare with that of stainless steel wire in transverse patellar fractures[10]. However, in that demonstration the authors not only used two loops of No.5 Ethibond, but they also used a different knot tying technique (an initial sliding knot followed by two additional throws) to replace the stainless steel wire and maintain fixation. In 2003, Harrell et al. demonstrated that four loops of Ethibond (920 N), rather than two (493 N), would be equivalent to load at failure of a single loop of stainless steel wire (910 N)[8]. Moreover, because braided polyester sutures are not as stiff as steel wire (31.7-59.1 vs. 320 N/mm), these sutures were suggested to be used as an alternative to stainless steel wire in compliant repair (support of a patellar tendon repair) rather than in rigid fracture fixation (tension band technique). If braided polyester was to be used to construct the tension-band, Hughes et al recommended the modified Wagoner's Hitch, rather than a double slip knot, to achieve a less interfragmentary gap[1].

Besides, the frequently added parallel Kirschner wires or screws in various band techniques have some biomechanical advantages that enable them to resist dynamic tensile stress. In 1994 Burvant et al. demonstrated that the adjuvant screws help reduce the number of displaced fragments in a simulated leg-extension model whose fractures were fixed with either a modified tension-band or the Pyrford technique[11].

In the present case, the sutures failed within six weeks after surgery and resulted in the loss of reduction. Considering our intraoperative findings in light of the above-mentioned biomechanical studies, the failure was probably caused by an insufficient number of suture loops, suboptimal knot tying, and no use of adjuvant Kirschner wire. Together, these conditions contributed to an unstable fixation unfavorable to bony union, as excessive motion during activities or interfragmentary gap will adversely affect the healing process. Furthermore, the resulting construct was more vulnerable to dynamic creep. Once the cumulative cyclic loadings exceeded the failure threshold of sutures before fracture healing in the present case, the material failed in such high stress areas such as the buttressed fracture surface and the bony corners.

Our case highlights the importance of proper surgical method when using nonmetallic sutures to treat patellar fracture. Like other case reports, we acknowledge the weakness of this report is that it is only a single case providing only indirect evidence and may not be generalized. However, as occurs with the introduction of any new method or material, any clinical complication is worthy of mention. Further biomechanical studies as well as large scale clinical trials are needed to verify the indications for nonmetallic sutures in fracture fixation.

Conclusions

Although the use of nonmetallic sutures as substitutes for stainless steel wire in the management of the patellar and olecranon fractures appears encouraging in orthopedic literature, we encountered a failed nonmetallic suture fixation for a transverse patellar fracture. Inadequate application of the alternative material resulted in an unstable fracture fixation and a final fatigue failure. With respect to the stable fixation required for bony union, we suggest that clinicians be aware of the inherent mechanical differences in alternative nonmetallic sutures and apply surgical techniques appropriate to the material, with special attention to the number of loops required, the security of the knots being tied and the use of adjuvant resisting devices to avoid possible fixation failure.

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Case Report

使用聚酯縫線固定橫向髕骨骨折失效：病例報告

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髕骨骨折約佔所有骨折的1%，常需要手術治療。最近，有人開始主張在特定骨折的內固定處理(包括髕骨和尺骨鷹嘴骨折)以不吸收聚酯縫線取代傳統的不銹鋼絲。這些材料被認為具有足夠的強度與方便使用的優點，但有限的研究規模甚至和使用所需求的操作經驗，使得應用此新固定方法於例行的骨折處理受到爭議。目前文獻中，較少有相關報告描述使用非金屬縫線固定的併發症。在此，我們報告一個使用Ethibond聚酯縫線固定橫向髕骨骨折失敗的病例。探討失敗原因為用於固定的迴圈數目不足和不當的繩結固定以致縫線無法負荷來自日常活動的反覆承載。為達骨折癒合所需的穩定結構，我們建議外科醫師在處理類似骨折時，應考量所使用固定材料的力學性質與相對應的手術技巧，減少後來的固定失敗。

關鍵詞：髕骨骨折、不可吸收聚酯、固定、失敗、Ethibond 縫線

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