

# Comparison of biodegradable and metallic tension-band fixation for patella fractures

38 patients followed for 2 years

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We compared the outcome of patella fractures fixed by biodegradable tension-band (B) with self-reinforced polyglycolide or self-reinforced poly-L-lactide plugs and polyester ligaments or by metallic tension-band (M) with Kirschner wires and metallic cerclage wire in a randomized study. 38 fractures (18 with B and 20 with M) were treated. The follow-up time was 24 (14–32) months. The fractures healed in all patients after a medium of 8 weeks. In the B

group, the clinical outcome was good in 13, fair in 4, and poor in 1 patient. In the M group, the corresponding figures were 15, 3 and 2. There were no clinical or radiographic differences between the two methods. Patella fractures can be treated, successfully using biodegradable tension-band fixation with no need for a second operation to remove the implants after bone union.

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In the past 20 years, the metallic tension-band technique has become the commonest method for patellar fracture treatment (Weber et al. 1980, Böstman et al. 1983, Levack et al. 1985, Bray and Marder 1988, Curtis 1990). However, a second operation to remove the implants is often necessary. We have also used a biodegradable tension-band with self-reinforced polyglycolide (SR-PGA) or self-reinforced poly-L-lactide (SR-PLLA) plug and polyester ligament. We conducted a prospective study to compare the clinical and radiographic results of metallic and biodegradable tension-band fixation.

## Patients and methods

As wires, we used Biopoly<sup>®</sup> polyester ligaments (LCCLALT, Type: 5062101-006, ARTICLE, France, length about 50 cm, diameter 1.5 mm). Charge of rupture was 650 N. This ligament was used together with self-reinforced polyglycolide acid or self-reinforced poly-L-lactide plugs (BIOFIX, Pu & Tai International Co, Ltd, Sweden, 50 or 60 mm in length, 2 mm in diameter). Their initial bending strength-value and shear strength were 250–350 Mpa and 170–220 Mpa, respectively.

38 patients (August 1, 1994 to February 1, 1996) with closed, displaced patella fractures were randomized to either the biodegradable tension-band (B) or

the metallic tension-band (M) treatment groups. All fractures were transverse or oblique with 2 or 3 fragments. Severe comminuted patellar fractures were excluded from this study. All the patients were over 20 years old. The study was approved of by the Ethics Committee of the Shanghai Bureau of Health.

*Operative technique.* A bloodless field was prepared under spinal anesthesia. A curved horizontal incision was made over the patella. The joint was cleaned. The fractures were reduced and kept in place with a clamp. In the M group, 2 parallel 2.5 mm or 2.0 mm K-wires were introduced. A 1-mm cerclage wire, having a figure of 8 configuration, was passed through the K-wire heads and ends. The fracture fragments were compressed more by twisting the ends of the wires. In the B group, the fractures were fixed with 2 PGA or PLLA plugs and a double polyester ligament in the same way (Figure 1). Plastic splints were used for 3 weeks. Weight bearing was allowed immediately postoperatively. Antibiotics were given until 4 days after the operation.

The patients were reexamined in the outpatient department at 3 and 8 weeks, 3 and 6 months, and at 1 year. The clinical and radiographic findings were evaluated every time (Table 1). Finally, all patients were followed between April 1, 1997 and May 31, 1997. The clinical and radiographic results were graded as good, fair or poor (Tables 2 and 3).

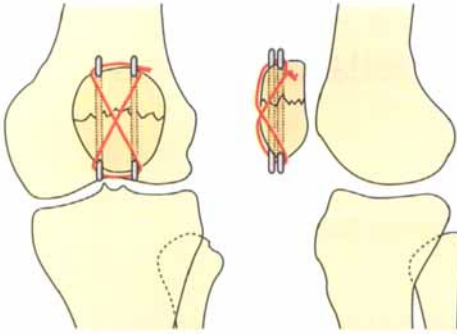


Figure 1. Technique of using biodegradable tension-band fixation for patellar fractures. Two SR-PGA or SR-PLLA plugs (grey) and one polyester ligament (red) were used to stabilize the fracture.

Table 1. Summary of patients with patella fractures

| Method | No. | Sex |    | Side |   | Age    |       | Days from injury to operation | Follow-up time (months) |       |       |
|--------|-----|-----|----|------|---|--------|-------|-------------------------------|-------------------------|-------|-------|
|        |     | F   | M  | L    | R | Medium | Range |                               | Medium                  | Range |       |
| BTB    | 18  | 5   | 13 | 9    | 9 | 45     | 24-72 | 1.7                           | 0-8                     | 23    | 14-32 |
| MTB    | 20  | 6   | 14 | 12   | 8 | 47     | 20-76 | 1.8                           | 0-7                     | 24    | 14-32 |

Table 2. Grading of clinical result

|      |  |
|------|--|
| Good | No more than slight or occasional pain<br>Loss of movement of less than 15° at the knee<br>Normally wound healing                  |
| Fair | Occasional to moderate pain<br>Loss of movement of 15-30° at the knee<br>Delayed healing of wound or aseptic swelling              |
| Poor | Constant pain<br>Loss of movement of more than 30° at the knee<br>Infection of wound or sinus tract formation<br>Operation failure |

Table 3. Grading of radiographic result

|      |   |
|------|---|
| Good | No step-off or gap in the articular surface<br>No loss of reduction     |
| Fair | Step-off or gap in the articular surface ≤ 1 mm<br>No loss of reduction |
| Poor | Step-off or gap in the articular surface > 1 mm<br>Loss of reduction    |

The Wilcoxon nonparametric test was used to assess differences between the 2 methods.

## Result

Bone union occurred in all fractures of mean 8 (6-12) weeks. The radiographic results were all good or fair

in both groups. No redisplacement due to ligament or metallic wire rupture occurred (Figure 2).

At the follow-up, 13/18 patients in group B had a good clinical outcome. Of 4 patients who had a fair outcome, 2 had had delayed wound healing, 1 complained of occasional pain and 1 had a reduction in knee motion of 20°. 1 patient had a poor outcome: he had a reduction of 35°. In the M group, 15/20 patients had a good clinical result. 3 patients had a fair outcome, 2 developed occasional pain and the other had a reduction in knee motion of 25°. 2 patients had a poor outcome, 1 developed infection and the other had a reduction of 40°.

We found no statistically significant differences in clinical and radiographic outcome between the two groups (Table 4).

Table 4. Result of operative treatment

| Method | Clinical <sup>a</sup> |      |      | Radiographic <sup>b</sup> |      |      |
|--------|-----------------------|------|------|---------------------------|------|------|
|        | Good                  | Fair | Poor | Good                      | Fair | Poor |
| B      | 13                    | 4    | 1    | 15                        | 3    | 0    |
| M      | 15                    | 3    | 2    | 17                        | 3    | 0    |

<sup>a</sup>  $p = 0.3$ , <sup>b</sup>  $p = 0.5$

## Discussion

In transversely or obliquely displaced patellar fractures, the metallic tension-band technique commonly results in a good outcome (Böstman et al. 1983). The only disadvantage is the need for a second operation to remove the implants. This could be avoided by using biodegradable material. An important question is whether it is strong enough to allow early mobilization. It has been calculated that forces through the patellar tendon increase from 850 N during level walking to 1900 N on climbing stairs (Morrison 1968). Theoretically, the strength of our biodegradable fixation was well above 1900 N and we found no refractures or redisplacements.

Polyester ligaments have been reported to be efficacious and not harmful (Amis et al. 1985, 1988, Fujikawa et al. 1994). Furthermore, intraosseous cellular response to biodegradable implants (Biofix) is



Figure 2. This 32-year-old had a patellar fracture which was fixed with BTB.

A, B. The fracture before the operation.

C, D. Anatomic reduction immediately after the operation.

E, F. Bone union 8 weeks after the operation.

mild and does not influence bone union (Miettinen et al. 1992, Paivarinta et al. 1993). In our study, all fractures healed uneventfully. Complications, such as delayed aseptic swelling or sinus tract formation, occurred in 5%–10% of patients treated for ankle fractures with SR-PGA (Böstman 1991, Böstman et al. 1992). None of these complications occurred in our patients and there were no infections. Nevertheless, 2 patients in the B group developed a slightly delayed wound healing—i.e., at 14 and 17 days postoperative-

ly. This may have been due to tissue reaction to plugs or ligament (Steinmann et al. 1990, Becker 1991, Marois et al. 1993). SR-PLLA plugs are absorbed in 3–4 years (Majola et al. 1991). SR-PGA and polyester ligament are absorbed in about 1 year (Vasenius et al. 1989).

The clinical and radiographic outcomes were good or fair in most of our cases and there was no difference between the groups. This suggests that biodegradable tension-band fixation with PGA or SR-PLLA plugs and ligaments is suitable for the treatment of patella fractures.

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