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Bone-peg grafting for osteochondritis dissecans of the elbow

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Abstract In the treatment of osteochondritis dissecans involving the elbow, we have used a bone-peg graft taken from the proximal part of the ulna and inserted into the defect. Thirty-two patients were followed from 2 to 10.5 years. The graft was utilised in 20 elbows, and 6 of these also had concomitant removal of a loose body. Another 6 elbows had removal of a loose body only. Ten elbows were treated conservatively in 5 of these the outcome was unsatisfactory, including 4 in which a bone-peg graft was later necessary. The bone-peg graft gave the best short-term results. Bony union of the dissecans site and reconstitution of subchondral bone required an average of 6.5 months. In 15 patients followed for a minimum of 5 years, the bone-peg graft was effective in limiting the development of osteoarthritis. Bone-peg grafting is a reliable method for treating osteochondritis dissecans of the elbow.

Résumé Pour le traitement des ostéochondrites disséquantes du coude, nous avons adopté une greffe de cheville osseuse, prise de la crête proximale du cubitus et l'avons insérée dans le site disséquant via la surface articulaire. Trente-deux patients ont été suivis de 2 à 10,5 ans. La greffe de cheville osseuse a été faite sur vingt coudes, et six d'entre eux ont aussi subi un retrait de corps libre. Le corps libre seul a été retiré sur six autres coudes. Dix coudes ont été traités sans opération, et cinq d'entre eux ont montré des résultats insatisfaisants. Quatre de ces patients ont subi une opération de greffe de cheville osseuse complémentaire. La greffe de cheville osseuse a donné les meilleurs résultats à court terme. La consolidation osseuse du site disséquant et la reconstitution de l'os sous-chondral a demandé en moyenne 6,5 mois. Sur quinze patients traités de manières diverses suivis pendant cinq ans, la greffe de cheville osseuse a limité le plus efficacement le développement de l'arthrose. La greffe de cheville osseuse est une méthode fi-

able pour le traitement des ostéochondrites disséquantes de coude.

Introduction

Osteochondritis dissecans (OD), which affects the articular surface and subchondral bone of the capitellum in the elbow joint, is a problem seen mainly in athletes who are involved in throwing sports [12, 16, 17, 19]. Conventional management is conservative [3, 8, 16, 20] including a prohibition of sporting activity, rest of the arm and surgical removal of any free bodies [4, 5, 9, 12, 18]. Treatment by these methods alone may lead to osteoarthritis (OA) [3, 8], however, and prolonged conservative treatment is tolerated poorly by school-age children. Therefore, operative treatment has been increasingly employed.

The bone-peg graft technique has been used in both osteochondral fractures and OD. Bandi [2] first used this method to treat OD in two knees, and Lindholm [13, 14], Johnson [10] and Gillespie [6] also employed this technique in the knee. Arcq [1] reported bone-pin fixation for a lesion of the capitellum which was associated with many knee defects.

We present a retrospective review of our experience in the treatment of OD of the elbow. Special attention was paid to the incidence of OA in our patients who were followed for over 5 years.

Materials and methods

Fifty-one patients with OD were seen at our Institution from 1980 to 1994; 32 were followed up for more than 2 years. The age at onset of the symptoms ranged from 12 to 17 years (average, 12.7 years). The age at the time of the initial consultation ranged from 12 to 20 years (average, 14.8 years). All patients were male, and all were affected in the dominant arm. Thirty-one of the 32 played sport and had a history of overuse of the elbow; 21 played baseball, and single individuals were involved in handball, basketball, kendo and gymnastics. One patient denied any history of sports activity.

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All complained of pain and limitation of motion of the elbow, and had an average total arc of motion of 116° (from 10° to 126° of flexion). The pain occurred during and after use, especially when playing baseball.

Evaluation of pain

The degree of pain was classified into 4 categories: no pain, occasional slight pain with no limitation in activities of daily living or sports, mild or moderate pain, and severe pain.

Radiographic assessment

OD was classified into 3 radiographical types based upon the AP view of the elbow joint, using a modification of Minami's classification [15]. Type I includes those elbows where a translucent cystic shadow is seen in the lateral or middle parts of the capitellum. Type II is the split-type, where a clear zone or split line is seen between the lesion and the adjacent subchondral bone. Type III includes those elbows with a loose body, where a split fragment has become completely separated from its bony floor. Of the 32 patients in our series, 8 were categorised as Type I, 14 were Type II and 10 were Type III. Tomography was used to determine the type of lesion when plain radiography gave ambiguous results, and was especially helpful in detecting split subchondral bone and differentiating Type I from Type II lesions.

The grade of OA was subjectively classified into 4 groups: no OA, slight OA, mild OA and obvious OA with or without a free body.

Treatment and follow-up

Conservative therapy, which was employed in 10 patients, consisted of complete rest of the arm and the application of a simple elbow brace. In 4 of these patients, surgery was eventually required, as there was no radiographical improvement after conservative treatment for more than one year.

Twenty-six patients underwent surgery, including 4 in whom operation was undertaken after failed conservative treatment. The bone-peg graft procedure alone was carried out in 14 patients and with removal of a loose body in 6. Six patients underwent removal of a loose body alone.

The period of follow-up ranged from 2 to 10.5 years with an average of 5.9 years, 7.2 years among the conservatively-treated patients, and 5.4 years in these managed by operation.

Operative technique for bone-peg grafting

Following exsanguination of the arm, the elbow is approached laterally through a J-shaped incision. The annular ligament is incised longitudinally. The capitellum is explored, and the articular cartilage and subchondral bone are inspected. The presence or absence of loose bodies is noted. Damage to the articular surface of the capitellum, notably fibrillation, softening, separation and defects in the cartilage, is usually more extensive than the area of the subchondral lesion which is apparent on the radiographs. If present, loose bodies are usually found in the radio-humeral joint.

Following inspection, the bone-pegs are inserted in the middle of the radiolucent area in Type I lesions and in the mid-portion of the bony area of the fragment in Type II. A hole approximately 3.0 cm in depth and 2.5 mm in diameter is made by inserting a Kirschner wire through the articular surface of the capitellum. The proximal part of the ulna is exposed through the distal aspect of the same skin incision. The bone graft (3 mm×3 mm×30 mm) is removed using a bone saw. The tip of the excised bone is sharpened using a rongeur. This bone-peg is inserted by hand into the hole made by the Kirschner wire and tapped into place using an impactor. The prominent part of the peg which protrudes from the

Fig. 1a, b Photograph and **b** radiograph illustrating the bone-peg graft method for osteochondritis dissecans of the elbow. Two bone pegs, taken from the proximal part of the ulna, were inserted into the dissecans fragment of the capitellum through the articular surface

capitellar cartilage is resected (Fig. 1). Two bone-pegs may be required for large lesions. All loose bodies are removed after checking the radial head fossa, the coronoid fossa and the olecranon fossa. After haemostasis and irrigation have been performed, the annular ligament is repaired and the skin is closed. A posterior plaster splint is applied with the elbow in 90° of flexion and the forearm in the neutral position.

Gentle active exercise and continuous passive motion are commenced 5 days after the operation and a dynamic splint is applied one week postoperatively. Sporting activities are prohibited until radiographs demonstrate bony healing of the radiolucent area or split zone.

Results

Symptoms

The average gain in the range of motion (ROM) as a function of treatment from the first visit to the latest follow-up was 7° in 14 bone-peg graft patients, 15° in 6 patients who underwent bone-peg graft with removal of a free body and 8° in 6 patients in whom removal of a free body only was performed. In contrast, there was a 2° decrease in 10 patients undergoing conservative management. A greater increase in the range of motion was seen in the bone-peg graft group (10° on average) than in groups without this procedure (2° on average) (Mann-Whitney U-test, $P<0.05$).

After conservative management or simple removal of a loose body the pain score improved by 2 grades in 3 of 16 patients and by one grade in 6 of 16. The score did not show any change in 7 of 16 persons. Patients treated with bone-peg grafting improved by 2 grades in 8 of the

Table 1 Clinical and radiographic findings in patients treated conservatively

Number of patient	Age	Type of lesion	Periods of conservative treatment (months)	Radiographic healing of OD site	Additional operation	Latest follow-up	
						Periods of follow-up (months)	Complication
1	15	I	5	Healed		84	Spur formation
2	13	I	24	Healed		50	
3	15	I	10	Insufficient		24	New loose body
4	12	I	13	Not healed	Bone-peg	36	New loose body
5	15	II	10	Healed		126	Spur formation
6	14	II	5	Healed		58	
7	12	II	6	Healed		29	
8	12	II	27	Not healed	Bone-peg	128	
9	14	II	12	Not healed	Bone-peg	49	
10	16	II	16	Not healed	Bone-peg	29

Fig. 2a–c **a** Representative example of a 15-year-old boy who showed a typical Type II lesion and underwent the bone-peg graft procedure. The articular surface of the capitellum shows a split in its lateral half, but the articular cartilage is well preserved. Two bone-pegs were inserted. **b** The lesion in the capitellum shows bony healing 4 months later. **c** Five years and three months postoperatively, the patient is pain-free and has a good result

20 and one pain grade in 11; there was no change in one. Statistically, the bone-peg graft group had more improvement than the other groups (chi-square test, $P < 0.05$).

Radiographic findings

Of the 10 patients treated conservatively, 5 achieved complete healing, one had insufficient healing with a persistent radiolucent area, and 4 experienced no improvement. Three patients developed a new loose body or spur (Table 1).

Among the 26 patients treated operatively, 15 of 16 with bone-peg grafts showed bony union of the dissecans fragment (Fig. 2); bone reconstitution of the radiolucent area was evident within an average of 6.5 months. Four patients with a Type I lesion healed in an average time of 4.7 months, while 10 with a Type II lesion required an average of 7.1 months for complete bony healing. One patient with OA treated by a bone-peg graft and resection of osteophytes did not heal. He was aged 20 years, and already had OA with segmentation and sclerosis of the dissecans fragment. In Type III lesions, 6 patients who underwent bone-peg insertion along with removal of a free body had healing of the radiolucent area at an average of 6.2 months postoperatively. In 6 patients who underwent removal of the loose body alone, bony union and reconstitution of subchondral bone took place after an average of 8.1 months; two developed new loose bodies and OA.

Long-term results

Fifteen patients were followed from 5 to 10.5 years. Their average pre-operative ROM ranged from 6° to 127° of flexion. Four patients had a Type I lesion, 5 a Type II lesion, and 6 a Type III lesion. Four individuals were managed conservatively, and 11 were treated surgically. Bone-peg grafts alone were used in 2 persons with a Type I lesion and 3 with a Type II lesion. A bone-peg graft with removal of loose body was undertaken in 3 patients and excision of a loose body alone in 3 with a Type III lesion. Conservatively treated patients had no significant change in ROM (2° average increase in extension; 2° average decrease in flexion) and 50% still complained of mild pain at the most recent follow-up.

Among the patients who were treated surgically, only one patient, with removal of a loose body alone, complained of mild pain. Two had no pain and 8 experienced occasional pain during heavy work. There were no problems in activities of daily living. In these persons the average ROM increased slightly (average, 5° increase in extension and 3° in flexion).

Radiographs revealed various grades of OA characterised by spur formation at the coronoid process and olecranon tip, and by hypertrophy of the radial head. In our series, OA occurred more frequently among persons with a Type II or Type III lesion than in those with an initial Type I lesion. The change in OA was compared in the conservative treatment, loose body removal and in the bone-peg groups. In the first group the OA stage advanced by one grade in 2 of 7 instances and by two grades in 3 of 7. In the latter group the OA stage advanced by one grade in 5 of 8 instances but none experienced a two grade advancement. The bone-peg group had better results than the conservative treatment and loose body removal groups, although this difference did not reach statistical significance.

Discussion

The aim of treatment for OD is rapid, stable healing of the fragment and prevention of osteoarthritic changes. To this end, we have mainly treated our many OD patients by bone-peg graft procedures. Our protocol consisted of a trial of conservative therapy, followed by surgical treatment, when necessary. Conservative management was usually continued for at least 6 months in patients with Type I or mild, early Type II lesions. Some of these persons elected for early operation in order to shorten the treatment period and permit an earlier return to sporting activities. In these persons, an average of 2.1 years had elapsed since the time of diagnosis and no radiographic evidence of improvement had been observed. An early operation was always undertaken in patients with late Type II lesions, where the osteochondral fragment was nearly separated, or with Type III lesions. Bone-peg grafts alone was performed for Type I and II lesions, and grafts with removal of the loose body in Type III lesions.

The graft restores the blood supply to the subchondral bone and promotes healing of the radiolucent area in Type I lesions, and promotes bony healing by fixing the split dissecans fragment in Type II lesions. A graft is used in Type III lesions when a radiolucent area or the split dissecans fragment is present after loose body removal.

Analysis of bony healing

Universally satisfactory results were not achieved using conservative treatment alone. In 11 patients with delayed surgery, healing was not achieved after 6 months of conservative therapy while 5 patients even failed to heal after one year. We do not therefore recommend prolonged conservative treatment. Furthermore, even in the operative group of patients, loose bodies recurred in 33% of those who underwent only simple removal.

The graft group had the best results in terms of improvement in clinical symptoms, and in the duration and rate of radiographic healing. This procedure is an excellent and reliable method for obtaining bony union of the dissecans fragments and reconstitution of subchondral bone.

The effect of time and age factors on bony healing in OD

We analysed how the interval between the onset of symptoms and the initiation of treatment affected the outcome. Patients in whom treatment was delayed for more than one year had inferior results and early treatment is therefore recommended. We also analysed how the age at the time of initial treatment affected the results, but no clear correlation was established. Linden [11] reported that patients with open epiphyseal plates of the femoral condyles in the knee could heal spontaneously but we were unable to replicate this finding in the capitellum. This may be because the average age of our patients at the time of presentation was already 14.8 years, and the majority already had closure of the epiphyseal line.

Development of OA in long-term follow-up

There have been no reports of the long-term results after the bone-peg graft procedure of the elbow. In order to analyse the long-term effects, we selected 15 patients in our series who had been followed for at least 5 years, with an average of 7 years after treatment. Two of the 4 patients treated conservatively still complained of mild pain at the most recent follow-up. In the 11 patients treated operatively, only one person, treated by simple removal of a loose body, still complained of mild pain. Eight of 11 patients complained of occasional pain which did not interfere with daily living or sporting activities. Although radiographs revealed various grades of

OA, this abnormality occurred more frequently in patients who initially presented with advanced lesions. This finding implies that the treatment of OD should be begun as early as possible. It is appear that the bone-peg graft prevents the development of OA more effectively than conservative treatment or removal of a free body alone.

On a basis of our successful results with regard to both healing of the dissecans lesion and the prevention of OA, we conclude that the bone-peg graft procedure is a reliable method for treating osteochondritis dissecans of the elbow.

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