Osteochondral Fractures of the Knee in Skeletally Immature Patients: Short-Term Results of Operative Fixation using Omnitech Screws

INTRODUCTION

Osteochondral fractures of the knee arise from acute traumatic injury that damages the articular cartilage of the knee joint. Osteochondral fractures differ in aetiology from other causes of osteochondral defect (i.e. osteochondritis dissecans) in that they occur as a result of trauma. They are most often found following patella dislocation, direct trauma or twisting injuries to the knee in adolescents (9, 14).

Adolescents are particularly vulnerable to this type of injury. The peak incidence of osteochondral fractures is 20 years (9). The cartilage of a skeletally immature person is found to predispose skeletally immature individuals to osteochondral defects (4, 5). It has been proposed that calcification of the tidemark is important for stability of the interface between cartilage and subchondral bone (9).

Furthermore these injury patterns are becoming more prevalent in today’s practice due to an increase uptake of competitive sporting activity in children and improved imaging allowing earlier diagnosis. Given that this pathology is not self-resolving entity it represents an important orthopaedic entity.

The role of articular cartilage is to provide a low-friction gliding surface minimizing peak pressures on subchondral bone (2) and to act as a shock absorber. These key functions emphasize its importance and injury may lead to early joint degeneration (15). There is limited ability to regenerate (8) and thus appropriate management is fundamental to reduce the long-term morbidity associated with injury to the articular surface.

Current practice includes three main surgical treatment approaches. First the defect may be fixed by securing the dislocated fragment, second the dislocated fragment may be removed and third a regenerative technique may be applied (9). The latter broadly involve bone marrow stimulation or chondrocyte engineering. Bone marrow stimulating techniques including microfractures, abrasion arthroplasty and drilling, used to encourage formation of fibro-cartilagenous repair tissue (5). Cartilage tissue based therapy such as mosaicplasty and matrix-assisted chondrocyte implantation (MACI) (16), whereby harvested cartilage is cultured and multiplied before being re-im-

ORIGINAL PAPER

PŮVODNÍ PRÁCE

Osteochondrální zlomeniny kolena u skeletálně nezralých pacientů: krátkodobé výsledky operační fixace s použitím Omnitech šroubů

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ABSTRACT

PURPOSE OF THE STUDY

Retrospective case series looking at the use of Omnitech compression screws for the management of osteochondral fractures in skeletally immature patients.

MATERIAL AND METHODS

Nine patients with a mean age of 14 were included in the study with a mean follow up of 26 months.

RESULTS

The average KOOS, IKDC and Tegner Lysholm Scores were 86.7, 90.34 and 96.1 respectively.

CONCLUSION

The use of Omnitech screws in the acute setting for skeletally immature patients shows excellent short-term outcomes.

Key words: knee, osteochondral fractures, Omnitech compression screws, adolescents.
planted back into the osteochondral defect. Fixation methods include the use of both absorbable and non-absorbable implants, with case studies focusing on bioabsorbable implants, fibrin adhesive and bone pegs (3, 6, 10, 11, 12, 17–19).

Although several studies investigate management of osteochondral fractures there is still disagreement on best management practice (9). We offer the first paper to look specifically at the use of Omnitech (non-absorbable) screws in the fixation of this type of traumatic injury in skeletally immature patients.

This retrospective single-centre study presents the short-term results following operative fixation of osteochondral fragments of the knee using Omnitech® (Biotech International, Salon-de-Provence, France) compression screws in skeletally immature patients.

MATERIAL AND METHODS

The knee database at our institution was retrospectively reviewed to identify children and adolescents who underwent surgery for patella dislocation, locked knees and trauma between 2008 and 2012. The inclusion criteria: an age criterion is applied, the patients must be under the age of 16 presenting to our institution with trauma between 2008 and 2012. The inclusion criteria were: 1. incomplete preoperative radiographs, 2. deviation from the standard protocol.

Exclusion criteria were: 1. incomplete preoperative radiographs, 2. deviation from the standard protocol.

Twelve patients were identified (12 knees) with nine patients (9 knees) completing follow up. There were two females and seven males with a mean age at operation of 13.1 years (range 12–16) for males. There were 5 left knees and 4 right knees (Table 1).

The causes of the osteochondral fracture were a twisting injury in 5 of the patients, 2 children had a knee that gave away, one locked knee and one generalized painful knee. All patients had new onset painful swollen knees in keeping with a recent injury.

Clinical outcome

Patients were evaluated at follow up clinically and by questionnaire using three validated scoring tools; the Knee Injury and Osteoarthritis Outcome Score (KOOS) (20), the International Knee Documentation Committee (IKDC) score (13) and the Tegner Lysholm Knee Scoring (TLKS) scale (7).

Radiographic assessment

Diagnosis of the osteochondral lesions were made on AP and lateral radiographs (Fig. 1) by an orthopaedic consultant and confirmed by a musculoskeletal radiologist. Magnetic resonance imaging (MRI) (Fig. 2) further characterized the lesion. Seven patients were found to have a defect on the lateral femoral condyle, one medial femoral condyle defect and one patella pole defect. On average, the surface area of the defects was 24.4 mm² (range 32.0–64.8 mm²).

Operative technique

Patients under general anesthesia were positioned in a supine position with a thigh tourniquet at 250 mmHg and leg bolster to allow arthroscopic evaluation of the osteochondral defect. A mini-arthrotomy was then performed to allow ease of access to the defect bed, which was prepared to receive the osteochondral fragment by gently curetaging to allow bleeding. The osteochondral fragment was then fixed to the defect under direct vision using Omnitech® screws (Fig. 3). These headless screws allow appropriate compression of the fragment onto the defect site and were buried under the articular cartilage. Three screws on average (range 1–5) were used for fixation of the fragments.

Post-operative treatment and rehabilitation

Post operatively, patients underwent a total of 6 weeks partial weight bearing in a hinged knee brace (Donjoy, USA), and then continued to be fully weight bearing. Post-operative radiographs were also taken at six weeks and 3 months (Fig. 4).

RESULTS

Post operatively patients were found to have a good range of movement with no wound complications at mean follow up of 25.6 months (range 12–53). The average KOOS score (out of 100) at final follow up was 86.7. This could be subdivided as follows; Pain, 93 (range 81–100), function in daily living (ADL), 97 (range 84–100), function in sport and recreation, 84

Table 1. Table providing demographic data and clinical outcome scores

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Side</th>
<th>Mechanism</th>
<th>Location of OCD</th>
<th>Total screws</th>
<th>Follow up (months)</th>
<th>KOOS</th>
<th>IKDC</th>
<th>Lysholm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16</td>
<td>Male</td>
<td>Right</td>
<td>Twisting injury</td>
<td>Lateral femoral condyle</td>
<td>4</td>
<td>12</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>Female</td>
<td>Left</td>
<td>Twisting injury</td>
<td>Lateral femoral condyle</td>
<td>3</td>
<td>20</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>Female</td>
<td>Left</td>
<td>Locked knee</td>
<td>Medial femoral condyle</td>
<td>2</td>
<td>23</td>
<td>80.3</td>
<td>80.5</td>
<td>89</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Male</td>
<td>Left</td>
<td>Giving away</td>
<td>Lateral femoral condyle</td>
<td>3</td>
<td>15</td>
<td>69</td>
<td>82.8</td>
<td>95</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>Male</td>
<td>Right</td>
<td>Twisting injury</td>
<td>Lateral femoral condyle</td>
<td>4</td>
<td>15</td>
<td>50</td>
<td>98</td>
<td>97.7</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>Male</td>
<td>Left</td>
<td>Giving away</td>
<td>Lateral femoral condyle</td>
<td>3</td>
<td>40</td>
<td>100</td>
<td>95.4</td>
<td>96</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>male</td>
<td>Left</td>
<td>Twisting injury</td>
<td>Lateral femoral condyle</td>
<td>3</td>
<td>31</td>
<td>94</td>
<td>100</td>
<td>98.9</td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>Male</td>
<td>Right</td>
<td>Twisting injury</td>
<td>Lateral femoral condyle</td>
<td>2</td>
<td>22</td>
<td>81.7</td>
<td>71.3</td>
<td>97</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td>Male</td>
<td>Right</td>
<td>Painful knee</td>
<td>Patella Pole</td>
<td>1</td>
<td>53</td>
<td>86</td>
<td>85.1</td>
<td>91</td>
</tr>
</tbody>
</table>
Fig. 1. AP and lateral radiographs of the left knee showing an osteochondral defect of the lateral femoral condyle.

Fig. 2. T2 weighted coronal and sagittal MRI of the left knee. An Osteochondral defect is seen within the lateral femoral condyle with associated bone bruising and large effusion present within the suprapatellar bursa.

Fig. 3. Diagram demonstrating position of the osteochondral defects on the femur and intra-operative pictures showing some of the osteochondral defects pre- and post-fixation.

Fig. 4. Postoperative AP and lateral radiographs of the left knee showing Omnitech® screws in situ, used to fix the osteochondral fragment to the lateral femoral condyle.

Fig. 5. Radiographic assessment + arthroscopy or MRI
Patients underwent a post-operative radiographs routinely. Subsequent imaging and investigations were led by clinical need as assessed by the operating surgeon during follow up. Two patients underwent MRI, which revealed well-healed osteochondral lesions with no evidence of screw protrusion (Fig. 5). One patient had a repeat arthroscopy for loose body symptoms three months after initial fixation where a small loose body unrelated to the fixation was removed. At time of arthroscopy it was noted that the old repaired defect was well healed with buried screws.

Complications
No patients had any intra-operative or immediate post-operative complications.

(range 55–100), knee related quality of life, 79 (range 44–100) and other symptoms, 77 (range 36–100).

The average IKDC scores at final follow up was 90.34 out of 100, with an average Tegner Lysholm Knee Score of 96.1.

Radiographic assessment + arthroscopy or MRI
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specifically at compression screws in surgical fixation
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biodegradable (L-lactide) pins in fixation of osteochondral
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Girls, 14 years for boys). These patients were followed
Chotel et al. conducted a retrospective multicenter study,
fixation in skeletally immature patients include the use
reduction and internal fixation of the osteochondral
fragment. Injuries should be treated as acute
headless compression screws to allow healing of the os-
chondral fragment. Injuries should be treated as acute
weight. The long-term effects of leaving these osteo-
chondral defects untreated include further articular
damage, associated meniscal injury and early onset os-
teoarthritis (16).

Previous reported methods of osteochondral defect
fixation in skeletally immature patients include the use
of screw fixation, restorable pins and pull out suture.
Chotel et al. conducted a retrospective multicenter study,
which looked at 14 patients (mean age 12.9 years for
girls, 14 years for boys). These patients were followed
up to average 30 months. No conclusion was drawn
about which method is preferred but that early treatment
is preferential (4).

Matsusue et al offered evidence to support the use of
biodegradable (L-lactide) pins in fixation of osteochondral
fractures in adolescents (11). Braune et al. used a different
type of bioabsorbable pin (poly-p-dioxanon) and concluded
that they are offered an acceptable result in short-term
follow up (7 months) (3). No paper has yet looked
specifically at compression screws in surgical fixation
of osteochondral fracture in skeletally immature pa-
ents.

Wouters et al. (19) studied the application of Meniscus
arrows® in the fixation of osteochondral fragments. The
study included five patients with only two patients
having long-term follow up (average 8 years). The re-
mainin three patients who all underwent repeat arthro-
scopies were found to have healed osteochondral lesions.
In this study there was no functional assessment to
assess patient outcomes, although two children returned
to their pre-injury activities.

Our short-term results have shown that the use of
Omnitech® screws allowed for good fixation of osteo-
chondral fractures with a return to normal activities in
all our patients. Our follow-up has shown that patients
are performing well in activities of daily living, with
subjective reduction in pain. All patients are back to
their pre-injury sporting activity. From our cohort, two
patients underwent further arthroscopies due to pain.
One undertaken three months post operatively for loose
body sensation where a small chondral fragment was
removed. At the time of arthroscopy, it was noted that
the screws were still well buried and there was good ev-
idence of healing of the osteochondral lesion. The
second patient complained of ongoing knee pain. His
repeat arthroscopy nine months post operatively showed
a single screw with 2 mm protrusion with no opposite
articular wear. This screw was removed, however the
patient continued to have the initial knee discomfort.
Additionally, two patients underwent post op MRI using
cartilage mapping acquisition sequencing. These found
well healed osteochondral lesions in both patients.

In this study, patients presented acutely to our services,
however it is recognised that a preceding osteochondral
injury cannot be ruled out. As all patients presented
with new onset symptoms, all injuries were regarded as
new defects within our study.

CONCLUSION

This short-term study shows that excellent outcomes
can be achieved in skeletally immature patients using
headless compression screws to allow healing of the os-
teocondral fragment. Injuries should be treated as acute
fractures requiring urgent imaging and then early open
reduction and internal fixation of the osteochondral
fragment.

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