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ELBOW

Encouraging mid-term outcomes for arthroscopic autologous osteochondral transplant (OAT) in capitellum osteochondritis dissecans (OCD)

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Abstract

Purpose The primary outcomes are the evaluation and quantification of pain relief and improvement in range of motion after OAT in OCD. The secondary outcomes are: resuming of sport activities, evaluation of the ADL recovery rate and subjective evaluation of the quality of life improvement.

Methods Nine patients, affected by an unstable and non-acute OCD lesion of the capitulum humeri, have been treated by the same surgeon. The patient mean age was 22.4 (16–45 years). All subjects were treated with the same surgical technique (arthroscopic OAT from the same side knee, a single cylinder of 6.5–9 mm in diameter) and underwent the same rehabilitation. The mean follow-up was 48 months (30–52 months). The authors documented the clinical assessment of each patient and carried out a questionnaire which included the VAS scale, MEPS Score and Quick DASH score. Patients were asked for MRI and radiographs pre- and post-operatively at follow-up.

Results The mean range of motion improvement was 17.9° in extension (range 13°–27°) and 10.6° in flexion (range 0°–20°) The VAS mean improvement was 7.1 (range 6–8) and the mean post-op value 0.6 (range 0–3). The MEPS score mean post-operative value was 98.3 (range 85–100). The Quick-DASH mean post-operative value was 2.5 (range 0–9.1) with a mean improvement of 41.4 points (range 36.4–47.7 points). All patients resumed sports in 6 months post-operatively.

Conclusions The autologous transplant of an osteochondral plug is a safe and promising procedure. Despite being more demanding, the arthroscopic approach is a valuable tool if the surgeon aims to reduce the invasiveness of the procedure, with all the consequent advantages.

Level of evidence IV Retrospective case series, therapeutic study.

Keywords Elbow · Osteochondritis · Cartilage · Arthroscopy · Sports · Osteochondral transplant

Introduction

Osteochondritis dissecans (OCD) is a localised condition that affects the cartilage and bone, resulting in the fragmentation of the underlying articular bone surface and the detachment of one or multiple fragments following necrosis [5, 22]. The exact aetiology is quite uncertain to date [7].

OCD is a well-acknowledged cause of elbow pain and disability; the most frequently affected area is the humeral capitulum.

Two kinds of classifications could be taken into consideration: one, proposed by Minami et al. [16], and modified by Bradley and Petrie [5], focuses on radiograph and MRI findings; the second, introduced by Baumgarten [2], considers arthroscopic findings.

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Young adolescents and athletes from 13 to 16 years old are more frequently affected by OCD which can cause recurrent pain, progressive reduction in function and limitation of the range of motion in more advanced cases, up to 30° impairment in extension [3]. The patient could also complain of posterolateral crepitation or popping and limitation of activities, affecting their ability to take part in sports. On examination, secondary joint contractures and lateral joint swelling may occur.

It is worth distinguishing OCD from Panner's disease, typically affecting boys below 10 years old with no history of trauma [18, 24], involving the entire ossification centre.

In the early stages, standard radiographs may appear normal or minimally altered in opacity. An AP view of a 45° elbow flexion could be useful to detect early signs [25]. In the advanced stages, loose bodies and joint irregularities may be detected.

MRI is the gold standard in diagnosis and essential for full lesion characterization, but sometimes it is not sufficient to determine the stability of the cartilage cap, which is an important aspect in opting for non-operative and operative treatment.

When treating unstable, chronic lesions between 6 and 10 mm, the chosen treatment is an autologous osteochondral single transplant from the omolateral knee. If the lesion is reachable perpendicularly from a posterior approach, an arthroscopic autologous osteochondral transplant can be carried out.

The primary outcomes of this study are the evaluation and quantification of pain relief and the improvement in range of motion after osteochondral transplant in OCD. Secondary outcomes are the return to sports, the evaluation of the ADL recovery rate and the subjective evaluation of the quality of life improvement after osteochondral transplant in OCD. The hypothesis is that this surgical approach allows to regain the complete function of the affected elbow in activities of daily living, in work and sports, restoring a hyaline cartilage layer into the joint.

Materials and methods

Between 2010 and 2015, the senior author treated, arthroscopically, nine patients affected by an unstable and chronic OCD lesion of the capitulum humeri with an osteochondral transplant. The patient mean age was 22.4 (range 17–45): 7 males and 2 females.

They were all involved in recreational sports activities at risk and complained of symptoms lasting for at least 1 year; no previous surgical treatment has been performed. The definite diagnosis was made on pre-operative radiographs and MRI findings. On an arthroscopic evaluation performed before harvesting the graft, all subjects that showed an unstable, non-fixable, osteochondral old lesions lower than 1 cm in diameter, were treated with the same surgical technique (arthroscopic OAT from the omolateral knee, a single cylinder of 6.5–9 mm in diameter) and followed the same post-operative protocol.

The mean follow-up was 48 months (range 30–82) (Table 1).

At follow-up, after an accurate and documented clinical assessment, the authors administered a questionnaire which included the VAS scale, MEPS and Quick DASH score.

Patients were asked for MRI and radiographs pre- and post-operatively at follow-up.

The protocol and informed consent process were approved by the local ethics committee (Ethical Committee Area Vasta Emilia Nord 14/2018/OSS/ESTMO—artic.elb).

Surgical technique [19]

The patient is in a lateral decubitus position with a shoulder abduction of 90° and an elbow flexion of 90° on an arm holder.

The surgeon performs an examination under anaesthesia to assess the ROM and stability. A tourniquet is applied and inflated.

Five arthroscopic portals are made: three posterior (two posterolateral and one in the olecranon fossa) and two anterior (anteromedial and anterolateral).

Table 1 Study population: ROM improvement

	Age at surgery	FU (months)	Pre-op ext	Post-op ext	Pre-op flex	Post-op flex	Post-op pro-supination	Post-op pro-supination
Mean value (range)	22.4 (16–45)	48 (30–82)	19.3° (10°–30°)	1.2° (0°–3°)	128° (120°–140°)	138.6° (130°–145°)	166.7° (160°–170°)	166.7° (160°–170°)
SD			6.3	1.5	8.6	5.1	4.7	4.7
Mean improvement (range)			17.9° (10°–27°)		10.6° (0°–20°)		0° (0°–0°)	
SD			5.1		6.4		0°	

Joint distension is achieved using a pump set on 35–50 mmHg.

First, the OCD lesion should be identified using the first posterolateral portal; switching the scope to the second posterolateral portal, the surgeon must evaluate if the lesion is reachable perpendicularly with a spinal needle. If the lesion area is too anterior on the condyle (with the elbow flexed at 90°), the surgeon will not be able to perform the technique arthroscopically and has to complete the procedure by opening the joint anteriorly.

If the lesion is on the posterior aspect of the condyle or it is possible to bring it to the back side with an elbow flexion, the surgeon may proceed arthroscopically.

The surgeon arthroscopically harvests a 6.5–9 mm cylindrical graft from the lateral trochlea of the ipsilateral knee using Mosaicplasty® instruments by Smith and Nephew, and places it into the previously prepared area that has to be perfectly covered.

A cylinder press-fitted makes the graft stable.

A long arm splint is placed posteriorly to immobilize the arm at 90° of flexion and neutral rotation.

Post-operative protocol

The involved arm is immobilized in a cast or a brace for 3 weeks, whereas mobilization of the wrist is allowed. Partial loading is allowed on the donor leg and maintained for 3 weeks; leg extension in open chain, squatting or kneeling cannot be performed for at least 1 month.

After 1 week, the therapist begins manual therapy with radio-humeral distraction and a cautious passive mobilization aimed at achieving the full ROM, avoiding valgus stress and closed chain exercises. Another goal is the progressive recovery of proprioception and kinesthesia. Laser therapy and PEMF could be helpful. Furthermore, ice therapy is recommended.

The therapist may introduce active exercises for muscle strengthening after full ROM recovery and when the patient is pain free.

Results

The mean range of motion improvement was 17.9° in extension (range 13°–27°) and 10.6° in flexion (range 0°–20°). All patients reached full flexion compared to the contralateral side and seven patients reached the full extension. Pro-supination remained complete after the operation (Table 1).

The VAS score was also evaluated (Table 2): the mean improvement was 7.1 (range 6–9 points) and the mean post-op value 0.7 (range 0–3). The MEPS score (Table 2) showed a complete recovery of ADL performance in 9 out of 9 patients, with full scoring of 8 out of 9 patients (mean improvement 38.3 points, range 30–50). Five out of nine patients reached the best score at the Quick-DASH (Table 2), four achieved 4.5 points (mean improvement 41.5 points, range 36.4–47.7).

All patients resumed sports 6 months post-operatively, one of them at a higher level than before, two of them to a non-competitive level by choice.

No complications following surgery were referred, except a case of anaphylactic shock, as a reaction to pre-operative standard administration of Cefazolin that was solved in one patient.

Multiple radiographs performed over time (Figs. 1 , 2) and MRI imaging requested at 6 months post-op and at the last FU showed satisfactory healing of the graft, no bone edema, a regular joint surface and a good osseous integration; no signs of degeneration or bone suffering were detected at the time (Figs. 3 , 4).

Discussion

The most important finding of the present study was that patient recovery is highly satisfactory even at 4 years' follow-up without any radiological sign of joint degeneration despite a full heavy-work activity and sports practice.

OCD lesions, as any other cartilage involving pathology, may raise difficulties for the surgeons concerning the right treatment option before a difficult choice about the right treatment option. The approach involved in the elbow

Table 2 VAS, MEPS and quick-DASH score improvement

	Pre-op VAS score	Post-op VAS score	Pre-op MEPS	Post-op MEPS	Pre-op quick DASH score	Post-op quick DASH score
Mean value (range)	7.8 (6–9)	0.7 (0–3)	60 (45–70)	98.3 (85–100)	44 (52.3–36.4)	2.5 (9.1–0-0)
SD	1	0.9	10.0	4.7	5.1	3.3
Mean improvement (range)	7.1 (6–9)		38.3 (30–50)		41.5 (31.9–47.8)	
SD	0.9		7.8		4.8	

Fig. 1 Post-op radiograph A-P view

Fig. 2 Post-op radiograph lateral view

Fig. 3 Post-op MRI imaging of the transplant at 6 months FU

Fig. 4 Post-op MRI imaging of the transplant at 6 months FU

localization of this disease is a debated topic in the recent literature and it is perhaps one step behind compared to the knee or the ankle localization. High-quality studies are indeed infrequent and, to date, a gold standard treatment does not exist. The current opinions are rather homogeneous about the conservative treatment that is a valid option when the diagnosis is made on a recent and stable lesion. The clinical outcome worsening has been related to bigger and deeper lesions [21]; the lateral column involvement seems to be a contraindication to the conservative approach [25].

The removal of an unstable fragment and the debridement, associated or not to drilling and micro-fractures, has achieved good results in small lesions (lesser than 1 cm in diameter), but only at mid-term follow-ups. Greater lesions did not show a good healing process and the superficial layer obtained was not so similar to the original one [1, 6, 11, 23, 25] and still entails a high risk of subsequent arthritis.

The open or arthroscopic fixation of the fragment is a valuable option and many techniques are described in literature

with rather good outcomes [9, 12, 20]; in any case, a second procedure is required for the fixation device removal. In addition, in 2008 Nobuta et al. showed that lesions deeper than 9 mm heal less frequently than the superficial ones if fixed [17].

When the fragment is not fixable, the OAT technique is indeed the only one that could provide the damaged articular surface with a hyaline cartilage top layer similar to the original one. Healing time is surely acceptable and the costs of the procedure are definitely low.

Yamamoto et al. presented the first and encouraging clinical results published in English; they performed an open technique with excellent functional outcomes in young throwing athletes (89%) [29]. In the same period, Tsuda et al. published a small case series: three non-throwing athletes treated arthroscopically had a good outcome at a short follow-up [26]. In the last decade, the literature showed the mid-term validity and reliability of this technique if applied at the elbow, as previously in the knee [13].

The surgeon can use just one cylinder or more plugs (mosaicplasty) evaluating the size of the lesion. Our choice to use a bigger single cylinder was based on scientific evidence of a better stability and higher complete healing rate of the transplant [10].

The selection of the donor site is still debated. There are encouraging data about local morbidity regarding the lateral aspect of the trochlea of the ipsilateral knee which we opted for. Recently, many other possibilities have been explored, but the results are not as positive [15].

Bexkens et al. published a systematic review on donor-site morbidity after osteochondral autologous transplantation for osteochondritis dissecans of the capitellum. They concluded that up to 7.8% of the patients complained of the knee after grafting [4]. Only one of the selected authors used a lateral throclear graft arthroscopically harvested of a similar diameter than our ones. His classification was one of the bigger ones and no pain or locking episodes were referred by the patients. All the morbidities were referred for multiple grafts harvested during arthrotomy. No knees complaints reported in this classification are consistent with the existing literature.

Gancarczyk et al. published an in vitro study where he performed an elbow arthroscopy on 21 specimens. He demonstrated that it is possible to achieve the right positioning of the recipient tunnels at the capitulum humeri, performing a proper OAT procedure [8].

This mini-invasive approach is successfully carried out since 2010, fostering the early post-op recovery and reducing the risks of stiffness, particularly in young people.

A recent systematic review published by Westermann et al. found better outcomes for OAT rather than other techniques, regarding the percentage of resuming sports. He also pointed out the absence of study populations treated homogenously as well as outcome evaluations performed using validated scales [27].

This study has addressed these doubts, but it has some limitations: first, the small number of cases, but this pathology affecting the elbow is indeed uncommon and it is even more rare to find a lesion that could fulfill our inclusion criteria for arthroscopic autologous osteochondral transplant. Second, a conservative treatment control group does not exist for a similar follow-up because of the unsuccessful attempts to treat these kinds of lesions in active patients in such a way. The open procedure is the standard one only for true mosaicplasties (multiple cylinders) in larger lesions but it is different and does not fit the criteria of a proper control group.

Consistent with the existing recent literature [28], this surgical approach can be currently considered a good choice for a successful, single step and long-lasting treatment in such kinds of lesions. Despite being more demanding, the arthroscopic approach is a valuable instrument if the surgeon wants to reduce the invasiveness of the procedure, with all the consequent advantages: a recent systematic review and meta-analysis of the existing literature reported that the rate of resuming sports and ROM recovery was more satisfactory in arthroscopically treated populations than in open surgery-treated ones [14].

Conclusions

The autologous transplant of an osteochondral plug is a safe and satisfactory procedure in active patients affected by capitulum humeri OCD. It is a valuable option even in case of failure of a previous simple debridement of the lesion.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest for this study.

Ethical approval The protocol and informed consent process were approved by the local ethics committee (Ethical Committee Area Vasta Emilia Nord 14/2018/OSS/ESTMO—artic.elb).

References

1. Bauer M, Jonsson K, Josefsson PO, Lindén B (1992) Osteochondritis dissecans of the elbow. A long-term follow-up study. Clin Orthop Relat Res 284:156–160
2. Baumgarten TE (1995) Osteochondritis dissecans of the capitellum. Sports Med Arthrosc Rev 3:219–223

3. Baumgarten TE, Andrews JR, Satterwhite YE (1998) The arthroscopic classification of osteochondritis dissecans of the capitellum. Am J Sports Med 26:520–523
4. Bexkens R, Ogink PT, Doornberg JN, Kerkhoffs GMMJ, Eygendaal D, Oh LS, van den Bekerom MPJ (2017) Donor-site morbidity after osteochondral autologous transplantation for osteochondritis dissecans of the capitellum: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc 25:2237–2246
5. Bradley JP, Petrie RS (2001) Osteochondritis dissecans of the humeral capitellum: diagnosis and treatment. Clin Sports Med 20:565–590
6. Brownlow HC, O'Connor-Read LM, Perko M (2006) Arthroscopic treatment of osteochondritis dissecans of the capitellum. Knee Surg Sports Traumatol Arthrosc 14:198–202
7. Eygendaal D, Bain G, Pederzini L, Poehling G (2017) Osteochondritis dissecans of the elbow: state of the Art. JISAKOS 1:1–11
8. Gancarczyk SM, Makhni EC, Lombardi JM, Popkin CA, Ahmad CS (2015) Arthroscopic articular reconstruction of capitellar osteochondral defects. Am J Sports Med 43:2452–2458
9. Graaff F, Krijnen MR, Poolman RW, Willems WJ (2011) Arthroscopic surgery in athletes with osteochondritis dissecans of the elbow. Arthroscopy 27:986–993
10. Hangody L, Dobos J, Balo E, Panics G, Hangody LR, Berkes I (2010) Clinical experiences with autologous osteochondral mosaicplasty in an athletic population: a 17-year prospective multicenter study. Am J Sports Med 38:1125–1133
11. Jones KJ, Wiesel BB, Sankar WN, Ganley TJ (2010) Arthroscopic management of osteochondritis dissecans of the capitellum: mid-term results in adolescent athletes. J Pediatr Orthop 30:8–13
12. Koehler SM, Walsh A, Lovy AJ, Pruzansky JS, Shukla DR, Hausman MR (2015) Outcomes of arthroscopic treatment of osteochondritis dissecans of the capitellum and description of the technique. J Shoulder Elb Surg 24:1607–1612
13. Kosaka M, Nakase J, Takahashi R, Toratani T, Ohashi Y, Kitaoka K, Tsuchiya H (2013) Outcomes and failure factors in surgical treatment for osteochondritis dissecans of the capitellum. J Pediatr Orthop 33:719–724
14. Lu Y, Li YJ, Guo SY, Zhang HL (2018) Is there any difference between open and arthroscopic treatment for osteochondritis dissecans (OCD) of the humeral capitellum: a systematic review and meta-analysis. Int Orthop 42:601–607
15. Maruyama M, Harada M, Satake H, Uno T, Takagi M, Takahara M (2016) Bone-peg grafting for osteochondritis dissecans of the humeral capitellum. J Orthop Surg 24:51–56
16. Minami M, Nakashita K, Ishii S (1979) Twenty-five cases of osteochondritis dissecans of the elbow. Rinsho Seikei Geka 14:805–810
17. Nobuta S, Ogawa K, Sato K, Nakagawa T, Hatori M, Itoi E (2008) Clinical outcome of fragment fixation for osteochondritis dissecans of the elbow. Ups J Med Sci 113:201–208
18. Panner HJ (1927) A peculiar affection of the capitellum humeri, resembling Calve-Perthes' disease of the hip. Acta Radiol 8:617–618
19. Pederzini LA, Tripoli E, DI Palma F, Nicoletta F (2015) Arthroscopic treatment of osteochondritis dissecans using mosaicplasty. In: Kelberine FM, Khan W (eds) Elbow Surgery. JP Medical Ltd, London, pp 7–10
20. Pill SG, Ganley TJ, Flynn JM, Gregg JR (2003) Osteochondritis dissecans of the capitellum: arthroscopic-assisted treatment of large, full-thickness defects in young patients. Arthroscopy 19:222–225
21. Savoie FH (2008) Osteochondritis dissecans of the elbow. Oper Tech Sports Med 16:187–193
22. Schenck RC Jr, Goodnight JM (1996) Osteochondritis dissecans. J Bone Joint Surg Am 78:439–456
23. Schoch B, Wolf BR (2010) Osteochondritis dissecans of the capitellum: minimum 1-year follow-up after arthroscopic debridement. Arthroscopy 26:1469–1473
24. Smith MGH (1964) Osteochondritis of the humeral capitellum. J Bone Joint Surg Br 46:50–54
25. Takahara M, Ogino T, Takagi M, Tsuchida H, Orui H, Nambu T (2000) Natural progression of osteochondritis dissecans of the humeral capitellum: initial observations. Radiology 216:207–212
26. Tsuda E, Ishibashi Y, Sato H, Yamamoto Y, Toh S (2005) Osteochondral autograft transplantation for osteochondritis dissecans of the capitellum in nonthrowing athletes. Arthroscopy 21:1270
27. Westermann RW, Hancock KJ, Buckwalter JA, Kopp B, Glass N, Wolf BR (2016) Return to sport after operative management of osteochondritis dissecans of the capitellum. A systematic review and meta-analysis. Orthop J Sports Med 4:1–8
28. Yamagami N, Yamamoto S, Aoki A, Ito S, Uchio Y (2018) Outcomes of surgical treatment for osteochondritis dissecans of the elbow: evaluation by lesion location. J Shoulder Elb Surg 27:2262–2270
29. Yamamoto Y, Ishibashi Y, Tsuda E, Sato H, Toh S (2006) Osteochondral autograft transplantation for osteochondritis dissecans of the elbow in juvenile baseball players: minimum 2-year follow-up. Am J Sports Med 34:714–720