Osteochondral lesion of the talus: possible treatment options for Thailand

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Abstract

Osteochondral defects (OCDs) of the talus is a broad term used to describe an injury or abnormality of the talar cartilage and adjunct bone. The treatment options vary from non-surgical treatment to a variety of surgical treatments depending on patient signs and symptoms. This review aims to provide an overview of treatment strategies that could be made available in Thailand. The pros and cons of several techniques including conservative treatment, fixation, microfracture, OAT and antegrade or retrograde drilling are discussed. We also provide suggestions for future development in OCDs of the talus care.

Keywords: osteochondral lesion of the talus, Thailand, conservative treatment, fixation, microfracture, osteochondral autograft transplantation, antegrade drilling, retrograde drilling

Introduction

There are a significant number of patients with Osteochondral defects (OCDs) of the talus in Thailand, but treatments for the disease have been limited, due to a lack of understanding about the nature of the disease, appropriate diagnoses and effective treatment guidelines. Besides, many surgical techniques and equipment introduced in current studies are not available in Thailand. Because these issues have been ignored, OCDs patients may develop several maladies including chronic ankle pain and ankle osteoarthritis, thus producing poor long-term quality of life. So far, there has not enough evidence to describe OCD treatment in Thailand. Therefore, this review aims to provide an overview of treatment strategies that could be made available in Thailand.

OCDs of the talus can have several causes, but the most common cause is from ankle injuries. The disease can develop from persistently repetitive forces or idiopathic ischemic articular cartilage (Mann & Coughlin, 1993; O'Loughlin, Heyworth, & Kennedy, 2010; Zengerink, Struijs, Tol, & van Dijk, 2010). A prominent investigation revealed 47 patients per 100,000 American soldiers' were found to have incurred the disease (Orr, Dawson, Garcia, & Kirk, 2011). In other studies, approximately 50% of patients with ankle sprains had OCDs of the talus. Also, the disease was reported in more than 50 to 78% of patients with an ankle fracture, but most of these were asymptomatic (Boraiah et al., 2009; Murawski & Kennedy, 2013; Nosewicz et al., 2016).

Since this date, studies involving OCDs of the talus have been published widely, except in Thailand. The lack of evidence regarding treatments in the Thai situation may result from several limitations. One of these limitations is that current diagnosis is usually made from radiographic imaging of the ankle. This method shows poor sensitivity resulting in an inappropriate clinical decision making. Other diagnostic methods, including CT or MRI imaging, are cost prohibitive, and thus are not widely used in Thailand. Furthermore, a diagnosis made by ankle arthroscopy would require a specialist easily found in high resourced settings, but not commonly found in regional care settings.

OCDs of the talus mostly present as a non-specific, ankle pain symptom associated with weight-bearing. Patients will often complain of chronic deep ankle pain with a history of prior ankle injuries. A physical examination often shows pain on the anterior part of the ankle, limited range of motion, stiffness, catching, locking and swelling. If an ankle plantar flexion test shows a positive result (the pain is observed when pressing the anterior ankle joint line), it may refer to OCDs of the talus. Patients who are suspected of OCDs of the talus require an ankle instability examination. An anterior drawer test is also recommended. As previously mentioned, radiographic imaging of the ankle shows poor detection of OCDs of the talus with a sensitivity of 0.59 and a specificity of 0.91. One study suggested the imaging should require the anterior-posterior (AP), lateral and Mortise views during weight-bearing stands (Verhagen et al., 2005).

If OCDs of the talus are suspected or detected on plain films, an important issue in the decision for treatment is whether a fragment is attached. Thus a further MRI or CT imaging is recommended. CT imaging can determine the size, location and whether patients have a subchondral bone cyst or not. The imaging will provide additional information in OCD patients where primary radiography has already defined the lesion. However, in cases where the plain film is not definite, OCD diagnosis can be made with MRI. The MRI will add information like staging and non-displacement of OCDs lesion (Kraeutler et al., 2017; Stroud & Marks, 2000).

Several disease staging systems are proposed regarding current diagnostic tools as described in Table 1. The gold standard for diagnosis and staging classification is arthroscopy. However, this method is invasive and may not available in some settings. Mintz and colleagues suggested MRI as an alternative diagnostic method for the OCDs of the talus (Mintz et al., 2003). They studied the accuracy of an MRI in the diagnosis of OCDs of the talus in 54 patients who had a history of ankle trauma and had undergone ankle arthroscopy. This study showed that an MRI correctly differentiates between patients with OCDs of the talus and healthy patients. They also found the MRI was able to determine the correct stage of the disease in 83% of the participants. Another study conducted by Bae and colleagues in 2012 compared MRIs with arthroscopy. They found that the results from MRI are concordant with arthroscopy in 65.9% of participants in identifying the stage of the disease. 20.5% of MRIs showed a more severe stage than arthroscopy, and 13.6% showed less severe (Bae et al., 2012).

Table 1 represents the stage of osteochondral lesions of the Talus with four diagnostic techniques.

Berndy and Harty radiographic classification	Hepple MRI staging system
Stage I: Subchondral compression (fracture) Stage II: Partial detachment of osteochondral fragment Stage III: Completely detached fragment without displacement from fracture bed Stage IV: Detached and displaced fragment Stage V: Subchondral cyst present	Stage I: Articular cartilage injury only Stage IIa: Cartilage injury with bony fracture and edema (flap, acute) Stage IIb: Cartilage injury with bony fracture and without bony edema (chronic) Stage III: Detached, nondisplaced bony fragment (fluid rim beneath fragment) Stage IV: Displaced fragment, uncovered subchondral bone Stage V: Subchondral cyst present
Ferkel and Sgaglione CT staging system	**Ferkel and Cheng arthroscopic classification**
Stage I: Intact roof/cartilage with cystic lesion beneath Stage IIa: Cystic lesion with communication to the surface Stage IIb: an Open surface lesion with an overlying fragment Stage III: Nondisplaced fragment with lucency underneath Stage IV: Displaced fragment	Grade A: Smooth, intact, but soft or ballotable Grade B: Rough surface Grade C: Fibrillations/fissures Grade D: Flap present or bone exposed Grade E: Loose, undisplaced fragment Grade F: Displaced fragment

Osteochondral lesion of the talus: available options for Thailand

As far as we concerned, there has been limited evidence of available treatment techniques of osteochondral lesions of the Talus in Thailand as well as reports on treatment outcomes from different techniques for patients living in the country. The researchers interviewed ankle orthopedic surgeons who work in tertiary hospitals and medical schools around the country. Our collective conclusions are as follows:

Non-operative Treatments

Non-operative treatments are used in asymptomatic patients suspected of having Osteochondral lesion of the Talus, for example for ankle-sprain-patients with a positive result on radiographic imagings or MRIs. Patients with mild symptoms and further investigations revealed non-displaced lesions or patients in early stages without bone pieces floating in the ankle (Berndt and Harty type 1 and 2 lesions and small type 3 lesions) are good candidates for conservative treatment (Klammer et al., 2015).

Recommended non-operative treatments include rest and avoiding exercise on the pathologic ankle. An NSAID is suggested to relieve pain. If patients have more severe symptoms, casting should be utilized for immobilization of the ankle during recovery over 3-8 weeks (Tol, Struijs, Bossuyt, Verhagen, & van Dijk, 2000). A case review of progression of the disease in patients with untreated Osteochondral lesions of the Talus was conducted by Klammer and colleagues in 2015. Forty-eight patients with an early stage of Osteochondral lesions of the Talus (Anderson classification grade I 50%, grade II 16%, grade IIA 22%) were included in the study. A 2-year follow up demonstrated that 86% of patients presented with no pain or complained of mild pain (VAS 0-3). Radiographic results showed 47% of patients had no sign of osteoarthritis and 27% had the first stage of osteoarthritis (grade I-II van Dijk classification) (Klammer et al., 2015).

Non-operative treatments have also been studied in the advanced stages of the disease. In 2002, Carl Shearer studied 34 patients with Osteochondral lesions of the Talus with Berndt and Harty stage V who were treated by non-operative methods. After a mean follow-up at 38 months, he found 34% of patients had an excellent outcome, 20% had a good outcome, 17% had a fair outcome and 29% had a poor outcome (Shearer, Loomer, & Clement, 2002).

Non-operative treatment strategies for osteochondral defects (OCDs) of the talus have substantially increased over the last decade. A recent study has shown that platelet-rich plasma (PRP) and intra-articular injection of hyaluronic acid (HA) help improve the outcome of non-operative treatments. These substances stimulate self-repair of the lesions, relieve pain and increase ankle movement (Mei-Dan et al., 2012). The study included 32 patients with moderate to severe OCDs of the Talus (Ferkel grade I-III, grade IIb/III) and divided patients into two groups: PRP and HA groups. An Ankle-Hindfoot Scale and a VAS were examined after 28 weeks. The study revealed a reduction of pain and an increase in the ankle movement in both groups. However, PRP groups presented better outcomes compared to the HA group (Mei-Dan et al., 2012).

Primary cartilage repair technique

Several surgical repairing techniques have been introduced as an alternative for patients for whom non-operative treatments are not effective. The surgical treatments can be performed using ankle arthroscopy and osteotomy techniques. A good candidate for a primary repair technique shows recent signs of OCDs of the talus (having signs and symptoms for less than six weeks); with radiographic imaging showing a fragment of cartilage that is large enough to fix with a surgical pin. Another criterion is a loose intra-articular fragment that can be reattached either by open or arthroscopic techniques. These techniques can provide a good outcome when the damaged cartilage is still of good quality and there are some parts of cancellous bone attached to the piece of cartilage. On the other hand, the clinical outcomes are not satisfactory when lesions are chronic and have a sclerotic border. (Badekas, Takvorian, & Souras, 2013).

The location of the lesions also affects the choice of treatment procedures. A lesion located on the anterior edge of the talus is more suitable for anterior arthroscopy and fixation. The surgeon can position the patient's ankle in plantar flexion. By turning the ankle to this position, lesions from the Tibial plafond will be more approachable for bone fixation (Kerkhoffs, Reilingh, Gerards, & de Leeuw, 2016).

For lesions located in the middle or posterior of the Talus, anterior fixation using arthroscopy is difficult and cannot be done in most cases. Nakagawa and colleagues proposed a new technique called arthroscopic tranmalleolar fixation (Nakagawa, Hara, Minami, Arai, & Kubo, 2010). The procedure is performed using 3-mm K-wire drilling to create a tunnel in the medial malleolus. The surgeon can use this tunnel as a direct channel to fix the cartilage lesion with surgical pins. By combining a position like plantar flexion or dorsiflexion, it provides a more direct approach to the lesion. However, these techniques are not popular and considered difficult as they require experienced foot and ankle surgeons to perform the procedure. It also can involve an adverse event of deterioration of the cartilage around the distal tibia.

In cases where arthroscopy is not an option, an ankle osteotomy can be an alternative for the surgeon. This technique is suitable in almost every lesion location. If the lesion is in the medial position of the talus, a medial malleolar osteotomy is recommended. However, an anterolateral tibial osteotomy is preferred when the lesion is in the lateral position. It should be noted though, that this procedure can cause non-union or a delayed union of the osteotomy site.

Although there are several fixation devices available in the market, the headless screw and bio-absorbable fixation device are the most accessible ones in Thailand. When fixation devices could be used for any reason, Kumai and colleagues suggested applying a cortical bone peg (created from the distal tibia) as a pin to fix the lesion. Their study included 27 patients where after a 7-year follow-up evaluation, a good outcome was obtained by 89% of participants (Kumai, Takakura, Kitada, Tanaka, & Hayashi, 2002).

Microfracture treatment

Microfracture is another treatment for Osteochondral lesions of the Talus aimed at inducing revascularization and subsequent stimulation of new fibrocartilage formation. This technique involves preparing the lesion bed by debridement of unstable cartilage. As the surface becomes a contained lesion, microfracture awls are punched into the subchondral bone to make small holes and open a zone of vascularization. The holes should be far enough from each other (3-5 mm) to prevent cracking. Physiological changes at the cartilage lesion site caused by microfracture allow bleeding to fill in the contained lesion. This process induces growth factors and progenitor cells from bone marrow to accumulate in the lesion. Subsequently, formation of fibrocartilage is obtained (Min et al., 2013). Even though new fibrocartilage is of a lesser quality compared to the original hyaline cartilage, the clinical outcomes from patients receiving this technique had proved to be satisfactory.

A systematic review to evaluate the results of osteochondral lesion treatment using the microfracture technique was conducted by McGahan and colleagues in 2010. Their findings revealed postoperative patient satisfaction scores, as measured by American orthopedic foot and ankle society (AOFAS) scale, were high (68 to 97), and a range of 39% to 96% of participants recruited in those studies showed good to excellent results. There were, however, limitations in the conclusion as each study in their reviews used different post-operative protocols.

However, most of these studies encouraged patients to initiate early joint motion, 6-8 weeks of partial weight bearing followed by full weight bearing at three months after surgery, and return to sports activities after 3-6 months (McGahan & Pinney, 2010).

Several advantages of the microfracture technique are described including the short duration of ankle immobilization, early weight-bearing and low morbidity; more importantly, graft harvesting from other organs is not necessary for this technique. Nevertheless, a disadvantage is that the newly developed fibrocartilage is not as strong as the original hyaline cartilage, and may result in the progression of cartilage degeneration.

Microfracture technique also has been using for the treatment of chronic osteochondral lesions of the talus. Ferkel and colleagues performed a microfracture technique on 50 patients suffering from chronic OCDs (Ferkel et al., 2008). The average onset of the disease to the surgery was 30 months (varying from 2-141 months). The 71-month follow up showed 72% of patents obtained a good clinical outcome with an average AOFAS score of 84.

The main factors that should be taken into consideration when deciding whether patients should undergo microfracture treatment are the size and location of the lesion. In 2009, Woo and colleagues conducted a prospective cohort study comprising 120 OCD patients treated with microfracture. They studied clinical failure after surgery, including repeated Osteochondral transplantation or an AOFAS score lower than 80. They found that clinical failure for patients was related to a lesion area larger than 150 mm^2 (Choi, Park, Kim, & Lee, 2009). Later in 2013, these researchers investigated the effect of OCD location, whether a contained lesion (non-shoulder lesion) related to a better clinical outcome or not. The study shows that 218 patients with contained lesions out of 399 patients (181 had non-contained lesions) had a higher AOFAS score and a lower VAS (Choi, Choi, Kim, & Lee, 2013). Since blood clot formulation was insufficient in the uncontained area, developing fibrocartilage could be hindered (Cuttica, Smith, Hyer, Philbin, & Berlet, 2011).

Others factors concerning a successful clinical outcome are operation tools and the depth of the microfracture holes. A microfracture tool is relatively expensive and not available in most hospitals in Thailand. Therefore, an alternative tool that is more economical could be proposed.

Choi and colleagues presented an alternative tool for microfracture (Choi & Lee, 2016). They compared 40 cases with K-wire drilling and 50 cases with microfracture. The study revealed that there was no significant difference reported between the two techniques in terms of AOFAS, VAS, and AAS scores. The results of a pathological study conducted by Chen and colleagues are concordant with their findings (Chen et al., 2011). Chen's study also investigated the relevance of the depth of microfracture holes and the quality of the newly developed cartilage. They examined the pathological changes of cartilage harvesting from 2-mm versus 6-mm microfracture holes. The study demonstrated that microfracture at a 6-mm depth resulted in a higher fill of cartilage, and a higher quantity of hyaline cartilage over fibrocartilage, together with an increase in glycosaminoglycan and type II collagen compared to microfracture at a 2-mm depth.

Although many clinical studies have found a positive outcome regarding microfracture, this treatment is not suitable for every case. A contraindication of microfracture technique is when patients have a subchondral bone cyst. Performing the technique in this case will lead to a poor clinical outcome. Since the cyst usually locates beneath the OCD lesion, it will not allow a sufficient amount of blood clot to fill in the contained area made by the microfracture technique. However, there was a diversity in trials concerning patient outcomes. In 2015, Lee and colleagues initiated a prospective cohort study obtaining 102 cases with OCDs of the talus with lesion sizes of less than 2 cm^2. Among these participants, 45 had subchondral bone cyst and 57 were non-cyst. All patients underwent microfracture and were followed for up to 48 months. Outcome measures including AOFAS ankle-hindfoot scale, VAS, and Ankle Arthritis Score (AAS) were determined. The results demonstrated no significant difference in clinical outcome among these patients (Lee, Park, Cho, & Seon, 2015). Another study was conducted by Han and colleagues in 2006. They compared the clinical outcome post microfracture among patients who had subchondral bone cysts smaller than 1.5 cm^2 and ones without cysts. The results also showed no significant difference (Han, Lee, Lee, & Kang, 2006). In conclusion, findings from the two studies imply that microfracture is appropriate for small to medium sized OCDs of the Talus with the size of subchondral bone cyst not larger than 1.5 to 2 cm^2

Continuing care after the microfracture operation is one of the keys to a successful clinical outcome. Recent publications have discussed two areas, early weight bearing and biologic augmentation (Guney, Akar, Karaman, Oner, & Guney, 2015; Lee et al., 2012). Previous literature suggested post-operative patients avoid weight bearing for 6-8 weeks for preservation of the quality and quantity of new cartilage formation (Mann & Coughlin, 1993; McGahan & Pinney, 2010). However, new studies have revealed that practicing post-operative weight bearing as early as 2 weeks or before 6-8 weeks also provides a good clinical outcome (Lee et al., 2012). Studies related to biologic augmentation have also shown amelioration of clinical outcomes in patients undergoing microfracture procedures. The variety of postoperative biologic augmentations, including platelet-rich plasma (PRP) and intra-articular hyaluronic acid (HA), are used widely. Guney and colleagues evaluated the effects of PRP injection on postoperative outcomes among patients receiving microfracture procedures by comparing 16 patients given microfracture treatment only to 19 patients given microfracture treatment and PRP injection. A 16.2 month follow-up revealed that the combined treatment with the PRP provided better clinical outcomes when measured by Foot and Ankle Ability Measurement (FAAM), AOFAS and VAS (Guney et al., 2015). An injection of PRP or HA as adjunct therapies after microfracture surgery also improved clinical outcomes. Görmeli and colleagues assessed the effect of HA and PRP treatment through a three-arm study in 2015 (Gormeli et al., 2015). They assigned 40 patients into three groups; a control group receiving saline, a PRP group, and an HA group. After an average follow-up duration of 15.3 months, patients were assessed by AOFAS and VAS scores. The PRP and HA groups presented significantly higher AOFAS scores and lower VAS scores compared to the control group. Patients with PRP were inclined to present a better outcome compared to the HA group

It should be noted that patients with OCDs of the Talus may require additional investigation to determine other concurrent pathologies. Ankle tendon tears, ankle fractures, or any surrounding untreated ankle injuries may result in more severe OCDs of the talus, leading to a poor prognosis of the disease or an unsatisfactory outcome. In 2015, a study compared 74 patients with Osteochondral lesions who suffered chronic lateral ankle instability with 148 patients who were without instability. The microfracture technique was used in both treatment groups. The study reported a higher failure rate and larger lesions in the group with chronic lateral ankle instability (Lee, Kwon, Choi, & Lee, 2015)

Osteochondral autograft transplantation (OAT)

OAT has been introduced as an alternative treatment of OCDs. This procedure involves reconstructive bone grafting techniques that use one or more cylindrical autologous osteochondral grafts harvested from non-weight-bearing portions of the patient's femoral condyle. The OAT technique begins with creating access to the site of the lesion in the pathologic ankle. The surgeon then measures the lesion size and prepares the area for graft transplantation. The autologous osteochondral graft is harvested from femoral condyle and is placed into the prepared area utilizing either an arthroscopic or a mini-open procedure. The indications for the necessity of OAT include: clinical failure on a previous microfracture technique, a lesion size greater than 150 mm^2, or a shoulder type lesion, (Choi et al., 2013; Choi et al., 2009; Cuttica et al., 2011) as well as large subchondral bone cysts (Berndt and Harty stage V).

There is no definitive conclusion whether microfracture is more effective than OAT, especially when the lesion is larger than 150 mm^2 or a shoulder type lesion (Choi et al., 2013; Choi et al., 2009; Cuttica et al., 2011). Moreover, even though the postoperative outcomes of OAT seem to be promising, it can involve complications by increasing the risk of donor site morbidity resulting from graft harvesting on the femoral condyle. Moreover, post-operative care following OAT is more complicated, and it also takes longer time when compared to microfracture. Patients undertaking OAT are recommended to restrict weight bearing for 6-8 weeks and can begin light exercises after three months post- surgery. The choice of a procedure as primary treatment should be discussed with patients. Advantages and disadvantages should be weighted, and the post- operative rehabilitation program should be explained as well.

For patients with an ankle fracture and first stage OCD of the talus (Berndy and Harty Grade I-II), conservative treatment shows good clinical outcomes. However, there is still no conclusion on for treatment guidelines among patients with more advanced stages (Berndy and Harty Grade III-IV). A study conducted in 2011 described 16 patients with acute OCDs grade III and IV who underwent OAT. After a 36.3- month follow- up, these patients reported a good clinical outcome with an average AOFAS score of 95.4 and no progression to arthritis (Liu et al., 2011)

While subchondral bone cyst is a contraindication for microfracture, it shows positive outcomes when treated by OAT. A prospective cohort study from Scranton and colleagues included 50 OAT patients and reported a successful result at 36 months post-surgery. An average Karlsson-Peterson Ankle score of 80.3 showing good to excellent results was obtained in 90% of participants. However, there were 26 cases where the defects were hard to reach via the usual OAT so medial malleolar osteotomy needed to be performed instead. There was only one case where donor site morbidity resulted from graft harvesting on the distal femur (Scranton, Frey, & Feder, 2006). Effective treatment outcomes after OAT were also described in a study by Woelfle and colleagues (Woelfle, Reichel, Javaheripour-Otto, & Nelitz, 2013). Woelfle included 32 patients with OCDs of the talus treated with this technique. They identified good treatment outcomes at 29 months with an average AOFAS of 86, VAS of 2.0 and HSS Patella score of 95. There was only one patient that had delayed wound healing and another one with non-union at the medial malleolar osteotomy site. They also conducted a post-operative MRI revealing abnormal findings in 14 out of 28 cases. However, these findings did not affect the clinical outcomes.

The major disadvantage of OAT is donor site morbidity. Using an arthroscopic approach or mini- open surgery, a region of healthy cartilage is identified, and a graft is harvested. These processes can destroy the donor bone site and cause morbidity, even though the site is non- weight bearing. However, the morbidity might not be as severe as the above theory suggests. A recent publication from Reddy and colleagues obtained data from 11 OCDs patients receiving osteochondral graft harvesting from the femoral condyle via arthroscopy. Results at a 47-month follow-up were reported to be successful in 5 patients (45%). Nevertheless, they found the sites and number of harvested grafts did not relate to clinical outcomes (Reddy, Pedowitz, Parekh, Sennett, & Okereke, 2007). Paul and colleagues investigated factors related to morbidity after osteochondral graft harvesting from a distal femur in 112 patients. Findings revealed the number of grafts, graft size and patient age did not associate with the morbidity outcome, while the BMI did (Paul et al., 2009). Another study by Woelfle and colleagues reported that age over 40 years also related to the morbidity outcome (Woelfle, Reichel, & Nelitz, 2013).

In an attempt to decrease the donor site morbidity, several suggestions have been proposed. Sammarco and Makwana suggested an alternative graft donor site consisting of the lateral talar articular facet of the same size of the lesion (Sammarco & Makwana, 2002). Fraser and colleagues recommended using biosynthetic plugs to replace the harvested site. This technique helps in reducing blood loss, promoting the regeneration of the collected cartilage, and initiating the healing process (Fraser et al., 2016).

Other drawbacks from OAT relate to invasive malleolar osteotomy including increasing risk of malunion or nonunion at the osteotomy site, longer period of limited weight bearing (6-8 weeks), and post-operative pain at the osteotomy site. Many surgeons have suggested different techniques to simplify and avoid disadvantages from malleolar osteotomy depending on the variety of the lesion locations. For a lesion in posteromedial talar dome, Sasaki and colleagues proposed a new technique using arthroscopy and drilling through a posteromedial approach to the medial malleolus. This creates a tunnel to place the osteochondral graft into the defected site. However, this technique is not without flaws. First, it is difficult to create a tunnel by drilling at a correct angle toward the lesion, even though it is performed under fluoroscopic guidance. Moreover, many surgeons may find making a tunnel perpendicular to the talar dome defect is the most challenging procedure. This approach also increases the risk of medial malleolar fracture (Sasaki, Ishibashi, Sato, & Toh, 2003).

For OCDs lesions located in the medial talar dome, medial malleolar osteotomy is required to gain access to the lesion. Several approaches can be performed during the osteotomy. These consist of straight transverse, inverted /U/V shape, crescentic, oblique, chevron, and step-cut osteotomy. However, when OAT is the choice of treatment, the graft placement should be perfectly perpendicular to the lesion. Many publications have recommended a surgeon to perform oblique and step-cut osteotomy as a standard approach. Recently, Lee and colleagues introduced a new approach called modified step-cut medial malleolar osteotomy. This newly developed technique can provide better perpendicular access to the central talar dome. An 8-week follow up report determined a successful clinical outcome (Lee, Yang, Moon, & Song, 2008).

For a lateral side lesion, the usual treatment procedure is an arthrotomy with plantar flexion of the ankle. By keeping the ankle in the plantar flexion position, the defected located in the anterior tibial talar dome should be able to be visualised and not blinded by the tibial plafond. However, if it is still not possible to be view the lesion, the surgeon has to address the lesion using either anterolateral tibial osteotomy or fibular osteotomy. The first approach is preferable because it avoids damaging the syndesmotic ligament and complications following fibular osteotomy (Gianakos et al., 2015; Tochigi, Amendola, Muir, & Saltzman, 2002).

The other technique to avoid osteotomy was introduced by Orr and colleagues in 2014. They modified an external fixator as a temporary invasive means of positioning the ankle. Once the distraction, plantar flexion, inversion and anterior translation are set; the lesion on the anterolateral and centrolateral talar dome can be seen and easily manipulated (Orr, Dutton, Nelson, & Hsu, 2014).

Another area of study that is becoming increasingly interesting involves use of a biological adjunct to improve treatment effectiveness following OAT. By filling the bone marrow aspirate concentrate into the graft receiver area, this technique draws an accumulation of hematopoietic and mesenchymal stem cells to the lesion. These substances then lead to acceleration of the healing process (Kennedy & Murawski, 2011).

Antegrade drill and retrograde drill

Microfracture and OAT are becoming popular options to treat OCDs of the talus according to the various advantages discussed above. However, in cases where a subtalar bone cyst is identified and the talar dome cartilage gets mildly injured but is still intact; microfracture or OAT may cause inevitable damage to this cartilage. To avoid this, antegrade or retrograde drilling can be a possible option for treatment.

Antegrade drilling or tranmalleolar drilling can be performed using ankle arthroscopy to identify the lesion. Then K-wire is drilled into medial malleolus toward the lesion under guidance from different angles of fluoroscopic imaging. Once the tip of the K-wire reaches the lesion, several additional drillings are made in the direction of the subchondral bone cyst under an ankle moving technique (Choi & Lee, 2016). The disadvantages of antegrade drilling are the collateral damage to distal tibial cartilage and talar dome cartilage which covered the cyst. Even though antegrade tranmalleolar drilling has some drawbacks, it is still considered a popular option due to its relative ease and satisfactory results. The method is reported to be equivalent to microfracture technique and is more beneficial in younger adults (Choi & Lee, 2016; Kumai, Takakura, Higashiyama, & Tamai, 1999).

To protect the integrity of the distal tibial and talar dome cartilage, the retrograde drilling method was developed. Firstly, ankle arthroscopy is done to determine the location of the lesion and whether the overlying cartilage is still intact or not. Then a non-weight bearing area in talus is drilled using K-wire. The non-weight bearing areas can be chosen from these different parts of the talus: the lateral process of the talus (Hyer, Berlet, Philbin, & Lee, 2008), and the connection area between talar neck and talar body, as well as the postero-lateral corner of the talus (Kono, Takao, Naito, Uchio, & Ochi, 2006). An anteroposterior (AP) and a lateral view from fluoroscopic imaging are examined to confirm the tip of K-wire location. Once the tip is precisely in the subchondral bone cyst, the pre-determined K-wire hole is expanded using canulated drilling. While the expansion is made, the acting surgeon should beware of breaking through the intact overlying cartilage. The last procedure is undertaken by injecting the bone graft or bone substitute into the hole (Kennedy, Suero, O'Loughlin, Brief, & Bohne, 2008). To date, retrograde drilling is a well-accepted procedure for treating OCDs with a subchondral cyst and an intact cartilage covering. Most case reports have revealed a satisfactory outcome after retrograde drilling with autogenous calcaneus bone graft filling (Taranow, Bisignani, Towers, & Conti, 1999).

To compare the effectiveness of anterograde and retrograde drillings, a case-control study of 30 OCDs patients without cartilage detachment was conducted by Kono and colleagues in 2006 (Kono et al., 2006). All cases had a mild OCD injury determined as grade 0-1 by modified Pritsch classifications. Nineteen patients underwent antegrade drilling, and the rest were retrograde. An investigation using ankle arthroscopy was performed at one year after surgery. The antegrade group was found to have a significantly worse morphologic outcome than the retrograde group (modified Pritsch classifications deteriorated from grade 0 to 1 in the anterograde group). However, the clinical outcome at two years post-surgery revealed no significant difference in AOFAS scores between the two groups.

Conclusions

An OCD of the ankle is a lesion of the talar cartilage and subchondral bone mostly caused by a single or multiple traumatic events, leading to partial or complete detachment of the fragment. Patients suffering from this disease normally present with intermediate or chronic pain. Symptomatic OCDs of the talus often require surgical treatment. However, the treatment of such disease in Thailand still has several limitations: lack of an understanding in early diagnosis, lack of appropriate treatment guidelines, limited choice of surgical equipment, and inadequately experienced foot and ankle specialists. In this review, we summarized treatment options that could be applied to the Thai situation. These options consist of primary fixation, microfracture, antegrade or retrograde drilling and OAT. We have discussed the pros and cons of these treatments. There is a great diversity in study outcomes indicated in this review concerning patient characteristics, staging of the defect, lesion size and location, the existence of a subchondral bone cyst, as well as patient's adherence to the post-operative rehabilitation program.

Base on the current evidence, treatment of OCDs of the talus still requires development in several areas. We suggest suspected OCDs patient to be admitted to an emergency department receive further investigations. More orthopedic surgeons and podiatrists in the country should be educated about the treatments discussed in this review. More availability of effective surgical procedures will lead to a better chance of improvement in patient outcomes.

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