Technical Note

Arthroscopic Resection of Lunotriquetral Coalition

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Abstract: Carpal coalition is a rare condition caused by a failure in the process of apoptosis. It is often incidentally diagnosed and seldomly symptomatic. The lunotriquetral joint is the most commonly affected joint, accounting for 90% of carpal coalitions. Minnaar classified the lunotriquetral coalitions into 4 types based on their type, extent, and associated abnormalities. Accurately classifying the coalition requires advanced imaging, and we show an example that includes 2-dimensional and 4-dimensional computed tomography and magnetic resonance imaging. Management of carpal coalitions include nonoperative and operative management. Splinting, anti-inflammatory drugs, hand therapy, activity modification, and steroid injections are all examples of nonoperative management. Operative management of coalitions in the carpus has historically been an arthrodesis whereas in the tarsal bones the gold standard is resection. Arthrodesis has a high complication rate and reduces wrist range of motion, whereas resection retains range of motion and allows the patient to return to activity sooner. We present 2 techniques of treating symptomatic carpal lunotriquetral coalition with arthroscopic resection.

Carpal coalition is a rare condition (prevalence 0.08%-0.13%) that is often asymptomatic and incidentally discovered.[1-3] Carpal coalition occurs due to a failure of segmentation. Normally, a cleft is formed by the 10th week in utero by apoptosis of certain cells within the cartilaginous precursor.[4] The severity of the coalition is dependent on the degree of failure of the process of apoptosis. It generally occurs between carpal bones in the same row, with the lunotriquetral joint accounting for 90% of carpal coalitions.[2,5] Diagnosing and classifying the coalition requires a thorough wrist examination and advanced imaging modalities to exclude other pathology.

The Minnaar classification system divides lunotriquetral coalitions into 4 groups.[6] Type 1 is often the most symptomatic but also the least common, representing only 2% of lunotriquetral coalitions.[2] It is characterized as an incomplete fibrocartilaginous coalition and has a pseudoarthrosis-like coalition where the cleft between the 2 bones is either covered with thin cartilage or devoid of complete cartilage formation. This can lead to localized degenerative arthritis and pain.[4] Type 2 and 3 have incomplete and complete osseous coalition, respectively, and are usually asymptomatic.

Management of carpal coalition usually begins nonoperatively, including splinting, anti-inflammatory drugs, hand therapy, activity modification, and steroid injections. The operative intervention most commonly mentioned in the literature is a lunotriquetral arthrodesis[7,8]; however it has a high complication rate and reduces wrist motion. A carpal coalition resection also has been described in the scaphotrapeziotrapezoid joint and had promising results without the complications of arthrodesis.[9] We considered that resection of the coalition would maintain the motion and still leave the option of arthrodesis if the patient remained symptomatic. We considered that this could be performed as a minimally invasive arthroscopic procedure. We present 2 techniques of arthroscopic resection of a symptomatic lunotriquetral coalition.

Indications

The following surgical technique is indicated for patients with a symptomatic carpal coalition that has been preoperatively assessed with careful clinical examination, simple radiographs, and advanced imaging modalities (e.g., computed tomography, magnetic

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The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received October 28, 2021; accepted November 21, 2021.

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2212-6287/211534

https://doi.org/10.1016/j.eats.2021.11.022

resonance imaging). The patient's carpal coalition must be the primary source of pain.

Surgical Technique (With Video Illustration)

Plain radiographs and advanced imaging are used to locate and quantify the lunotriquetral coalition (Fig 1). A standard wrist arthroscopy with traction is performed. We first attempt to visualize the lunotriquetral ligament and coalition from the 3-4 radiocarpal portal, but it can be difficult to identify due to the minimal movement within the joint. Switching the viewing portal to 6R allows the coalition to be viewed from a different perspective (Table 1). We use a 23G hypodermic needle to help identify the joint and confirm this with fluoroscopy. An 2-mm straight burr (Arthrex, Naples, FL) is advanced into the interval and used to debride and resect the interval. We regularly check the position to ensure correct progression (Fig 2). Interestingly on initial debridement of the coalition, the widening can be visualized from the radiocarpal joint as the coalition is resected. We then view the lunotriquetral joint from the midcarpal joint and confirm with an arthroscopic probe that the interval is within normal limits with no instability (Video 1). A DYONICS Platinum 3.5-mm shaver (Smith & Nephew, Andover, MA) is then used to debride any remaining tissue (Fig 3).

Alternative Technique

An alternative technique using the same concept can also be used. The carpal coalitions are reviewed on plain radiographs and advanced imaging and correlated with the patient's symptoms (Fig 4). A standard wrist arthroscopy is performed. The lunotriquetral joint is identified and a 2.5-mm drill bit (DePuy Synthes, Warsaw, IN) passed into the joint. If a 2.5-mm drill bit is not available, then a drill of similar size is also acceptable. The position of the drill is confirmed with fluoroscopy before commencing the drilling (Fig 5). One to two passes of the drill are made at different levels of the lunotriquetral joint (Fig 6). A lateral fluoroscopic image is taken to ensure adequate depth of the drill bit (Fig 5B). The joint is then visualized through the midcarpal portal and probed to confirm stability (Fig 6). We repeat the same process with the drill bit for the capitohamate joint, specifically focusing on the partial coalition identified on preoperative advanced imaging.

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Preoperative advanced imaging is critical to planning	Failing to accurately locate the joint and coalition
Arthroscopic localization of the lunotriquetral interval	Destabilization of the joint by over-resection
Intraoperative fluoroscopy ensures accurate location of resection	Under-resection of the coalition
A side cutting micro-burr allows accurate and controlled resection	Cartilage damage caused by the micro-burr or drill

Rehabilitation

One of the advantages of this technique is the fact that the patient can start mobilizing and progressively strengthening the wrist as soon as comfort allows. We place a bandage on the patient, which is removed after 24 hours. The patient begins with gentle range of motion and progresses with therapy as comfort allows.

Discussion

If nonoperative management is unsuccessful, we elect to perform a resection of the coalition and debridement of the lunotriquetral joint. The advantage to this technique is the fact that we are attempting to restore normal anatomy and wrist/carpal kinematics (Table 2). We have confirmed that we did not destabilize the joint; however, we do appreciate that this is a possible risk when performing this procedure and care must be taken not to over-resect. A similar concept was published in 2013, which described a symptomatic scaphotrapezial joint coalition resection and fat

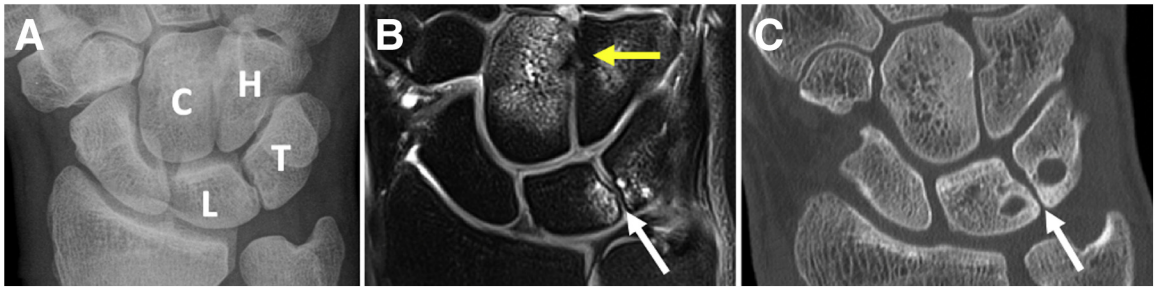

Fig 1. Simple and advanced imaging is essential to review prior to surgery. (A) Plain-film anteroposterior radiograph shows joint space narrowing, subchondral cysts, and sclerosis of the lunotriquetral joint and a similar appearance at the capitohamate joint. (B) T2-weighted fluid-sensitive coronal-slice magnetic resonance image shows edema and cysts present in the bones involving the lunotriquetral (white arrow) and capitohamate joints (yellow arrow). (C) Coronal computed tomography slice highlighting the cystic changes and sclerosis at the lunotriquetral joint (white arrow). (C, capitate; H, hamate; L, lunate; T, triquetrum.)

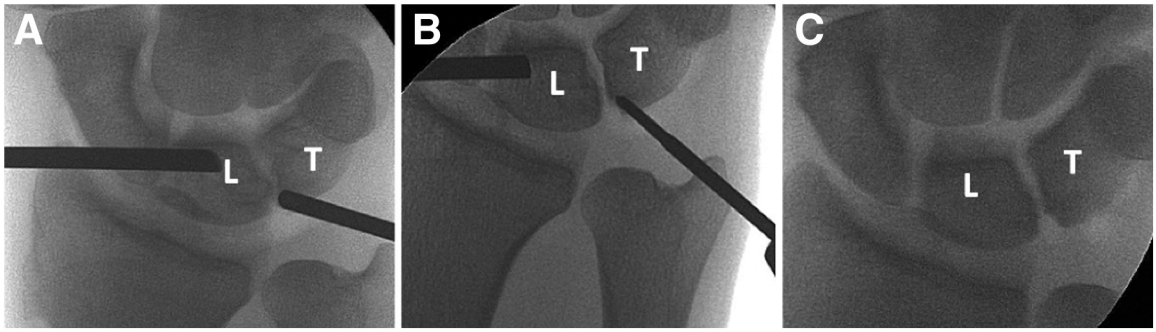

Fig 2. Intraoperative fluoroscopy. (A) Visualisation is through the 3-4 midcarpal joint portal. An arthroscopic trocar is placed through the 6R portal in the radiocarpal joint and is confirmed within the lunotriquetral joint. (B) An intraoperative fluoroscopy shot was taken shortly after commencement of the resection. We identified that we were deviating ulnar-wards, so this was able to be corrected. (C) Final fluoroscopy showing the lunotriquetral joint space adequately resected. (L, lunate; T, triquetrum.)

interposition.[10] The treatment alleviated the patient's symptoms.

The principles of the surgical techniques are reasonably straightforward, but they do require an experienced surgeon and the use of fluoroscopy. In this case, the patients made a rapid recovery and were able to return to activities of daily living. Potential complications of this technique are the risks of arthroscopy (nerve, tendon, or cartilage injury), causing instability with over-resection and continued pain if under-resection occurs. We strongly recommend the use of fluoroscopy throughout the case to ensure that the correct joint and amount is resected.

The literature has described arthrodesis of the lunotriquetral joint as the preferred treatment method.[11] A high rate of complications has been previously

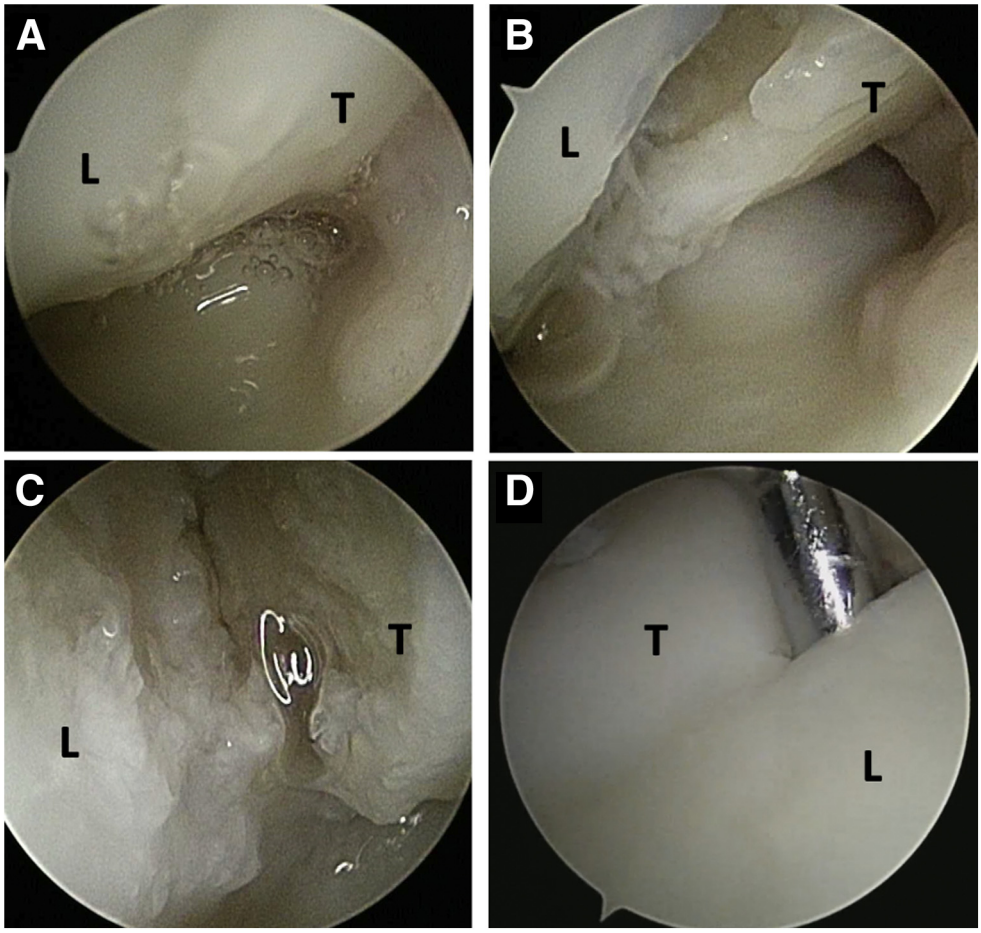

Fig 3. Arthroscopic intraoperative images. (A) The patient is undergoing a wrist arthroscopy with the wrist in an arthroscopic traction setup. Via the 3-4 radiocarpal joint, the lunotriquetral interval is difficult to appreciate. The use of a probe is useful but often fluoroscopy is necessary. (B) The lunotriquetral interval after resection. (C) A better view of this is obtained via the 6R portal to ensure that the resection is evenly resected both dorsally and volarly. (D) It is important to probe the lunotriquetral joint from the midcarpal portal to assess stability after resection. (L, lunate; T, triquetrum.)

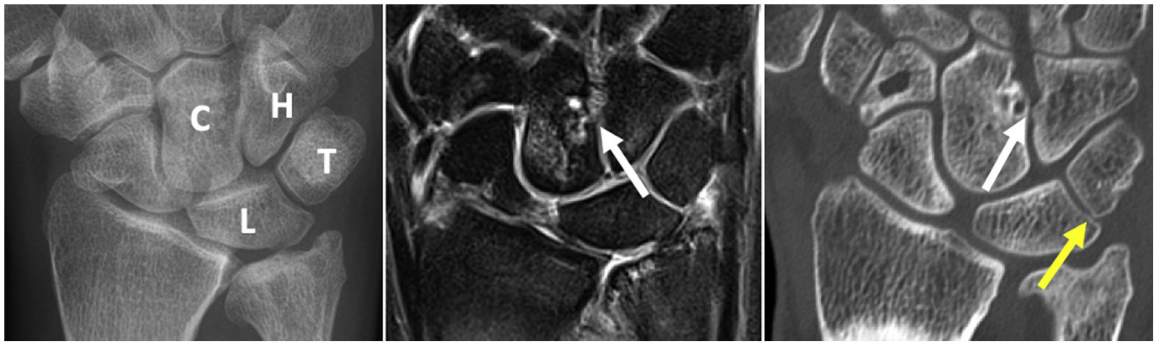

Fig 4. Radiograph and advanced imaging (computed tomography coronal slice and T2 fluid-sensitive coronal magnetic resonance imaging) of a patient with wrist pain. Partial coalition of the capitohamate joint with cystic changes evident (white arrows). Narrowing of the lunotriquetral interval highly suspicious of a partial coalition (yellow arrow). Ulnocarpal impaction with associated degenerative changes. (C, capitate; H, hamate; L, lunate; T, triquetrum.)

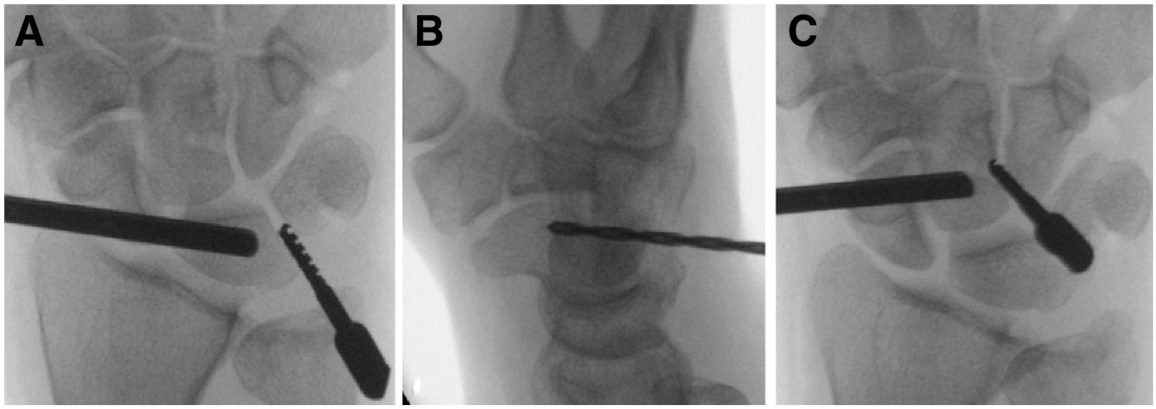

Fig 5. Fluoroscopic images of the alternative technique. The lunotriquetral interval was identified and a 2.5-mm short drill bit was placed through the radiocarpal portal and the position was confirmed with fluoroscopy. A lateral image was taken to ensure the appropriate depth has been resected. The process was repeated for the capitohamate joint through the midcarpal portal.

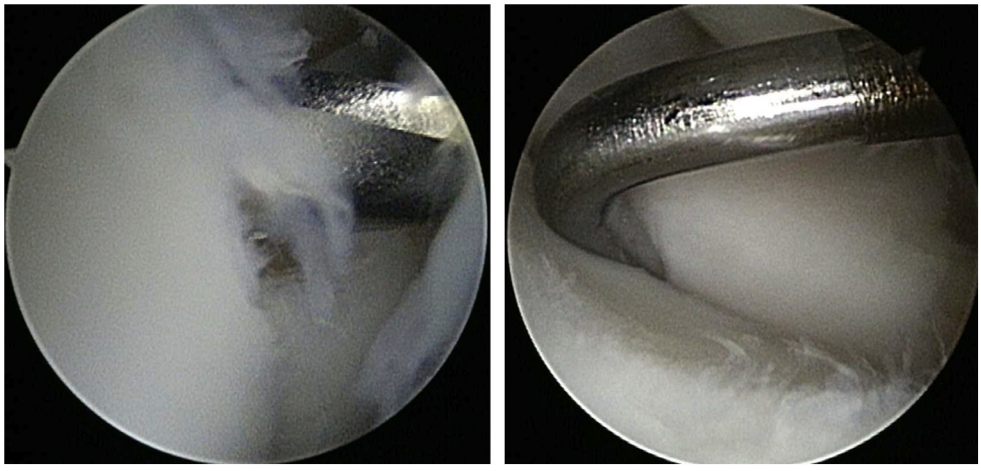

Fig 6. The patient is undergoing a wrist arthroscopy with the wrist in an arthroscopic traction setup. Intraoperative arthroscopy photos show a 2.5-mm drill bit entering the lunotriquetral joint under direct vision via the 3-4 radiocarpal portal. This was also confirmed before commencing with fluoroscopy. After the completion of drilling, the lunotriquetral joint was probed from the midcarpal portal to assess stability.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Minimally invasive motion preserving procedure	Advanced arthroscopic skills are required
Simple technique with few technical factors	Risk of collateral damage
Avoids need for LT fusion and implants	
Early active mobilization within 1-2 weeks	
LT fusion can still be performed if required	

LT, lunotriquetral.

published with lunotriquetral arthrodesis secondary to instability; however, the results are better for patients with a carpal coalition. A concern with arthrodesis is the altered mechanics that it may create at the scapholunate and lunocapitate joint, which may result in accelerated degeneration of the carpus. Our technique does not need to rely on the use of implants, bone grafting, postoperative immobilization, or bone healing and will allow the patient to resume normal activities sooner than with arthrodesis. The longer-term results of our technique are not available due to the rarity of the condition and the limited case numbers that require operative intervention. We can, however, extrapolate from long-term results from the foot where the open excision of the coalition is gold standard. Good-to-excellent results were published from a long-term (>10 year) study of 24 patients with 32 tarsal coalitions.

In summary, these are relatively simple techniques to treat symptomatic carpal coalition whilst minimizing potential complications when compared to arthrodesis. Long-term follow-up and more cases are required to provide more accurate results of this technique.

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