Gas Arthroscopy for Removal of Osteochondral Fragments of the Palmar/Plantar Aspect of the Metacarpo/Metatarsophalangeal Joint in Horses

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Objective—To evaluate the use of carbon dioxide (CO2) gas for joint distention during arthroscopy for removal of osteochondral (OC) fragments of the palmar/plantar aspect of the metacarpo (MCP)/metatarsophalangeal (MTP) joints in horses.

Study Design—Clinical study.

Animals—Horses (26) with OC fragment(s) of palmar/plantar aspect of 1 or 2 MCP/MTP joint(s).

Methods—OC fragments were removed using arthroscopic technique. Joint distention was maintained by isotonic Ringer’s acetate at the beginning and at the end of the procedure but during fragment removal, CO2 was used for joint distention. After surgery, fragment removal was confirmed by radiography. Horses were discharged the day after surgery, and outcome was determined by telephone contact 3–24 months later.

Results—CO2 joint distention resulted in a sharp image without villi obscuring the operative field. Fragments were identified and completely removed in all horses except one where a 1 mm \( \times \) 3 mm radiodense body was seen on postoperative radiographs. In 5 horses, bleeding from the arthroscopic or instrument portal precluded optimal visualization when the joint was distended by gas; however, repeatedly rinsing the tip of the arthroscope with Ringer’s acetate solution delivered from the fluid ingress line easily restored joint visualization. No specific complications were observed postoperatively.

Conclusions—Joint distention by CO2 permitted optimal visualization of the palmar/plantar aspect of the MCP/MTP joints, which facilitated fragment removal.

Clinical Relevance—Gas arthroscopy is a useful technique for removal of OC fragments of the palmar/plantar aspect of the MCP/MTP joints in horses.

Key words: arthroscopy, carbon dioxide, osteochondral fragment, metacarpophalangeal joint, metatarsophalangeal joint, horse.

INTRODUCTION

STERILE POLYIONIC fluid is the most commonly used medium for joint distention during both diagnostic and surgical arthroscopic procedures in the horse. The use of gas to distend the joint was first reported by Bircher who used a mixture of oxygen and nitrogen to inspect the human knee joint, and subsequently other reports describe gas arthroscopy in human patients. Advantages of a gas medium are a sharper image, no tissue motion, and compression of synovial villi so that the visual field is not obscured. Reported complications of gas arthroscopy in human patients range from transient periarticular emphysema to fatal venous air embolism.

The objectives of this study were to evaluate the usefulness of gas arthroscopy during removal of osteochondral...
(OC) fragments from the palmar/plantar aspect of the metacarpo (MCP)/metatarsophalangeal (MTP) joint and to identify possible technical problems and complications that might be associated with this technique in horses.

**MATERIALS AND METHODS**

Twenty-six horses admitted between October 2001 and September 2003 for arthroscopic removal of OC fragments of the palmar/plantar aspect of the MCP and MTP joints were studied. Not all horses admitted for arthroscopic fragment removal during this period were included because of occasional gas supply problems. There were 20 Standardbreds and 6 Warmbloods, aged 1–8 years (mean, 2.5 years), and 13 were males (3 geldings and 10 stallions) and 13 were females. Of 34 fragments, 31 were in MTP joints and 3 were in MCP joints. The medial aspect of the joint was the most common fragment location (27 fragments; 79.4%). Four (15.4%) horses had bilateral fragmentation, 3 horses (11.5%) had concurrent medial and lateral fragments within the same joint, and 1 horse (3.8%) had 2 medial fragments within the same joint.

**Surgical Technique**

After induction of general anesthesia, the horses were positioned in lateral recumbency with the medial or lateral side (depending on fragment location) of the affected limb facing upwards. The skin between the carpus/tarsus and the coronary band was clipped and aseptically prepared. The surgical site was draped, taking special care to pad the hoof. After distention of the MCP/MTP joint with approximately 35 mL of Ringer’s acetate solution, an arthroscopic portal was made in the most proximal aspect of the palmar/plantar joint pouch, using a technique reported by McIlwraith and Foerner.10

The arthroscopic procedure was performed with the surgeon standing at the distal aspect of the limb and facing towards the body of the horse. The toe of the horse’s hoof lay against the abdomen of the surgeon. This position allowed the surgeon to control the degree of flexion placed on the joint during surgical manipulation.11 A 30° forward viewing, oblique, 4-mm arthroscope (Smith & Nephew, Andover, MA), to which a digital video camera was attached, was inserted to visualize the base of the ipsilateral proximal sesamoid bone and the distal palmar/plantar metacarpus/metatarsus. An arthroscopic sleeve with 2 stopcocks, allowing simultaneous connection of a fluid and a gas ingress line, was used.

A 19-gauge needle was inserted horizontally through the ipsilateral collateral sesamoid ligament, into the most distal aspect of the joint. The needle was used to confirm the location of the OC fragment and to ensure a suitable location for the instrument portal which was made by stab incision (No15 Bard-Parker blade, Swann Morton, Sheffield, UK). Joint distention was initially maintained by continuous irrigation with Ringer’s acetate solution (Fresenius Kabi AB, Uppsala, Sweden) delivered by an automated arthroscopic pump. After creation of the instrument portal, carbon dioxide (CO2) was used to maintain joint distention. CO2 was delivered by a pressure regulator and a gas cylinder (Arthroflator, model 28, Karl Storz, Tuttlingen, Germany). The gas ingress line was connected to a gas filter (Gas filter with tube, Karl Storz) to avoid contaminating the pressure regulator in case of reverse flow of fluid from the joint. The gas pressure was set at 100 mmHg.

The OC fragment was partially separated from the soft tissue with a sharp elevator and subsequently grasped by using a Ferris-Smith cup rongeur and rotated several times along its long axis to ensure that all soft tissue attachments were disrupted before removal from the joint. To ascertain complete fragment removal, any loose tags of soft tissue were removed with Ferris-Smith cup rongeur or a motorized arthroscopic soft tissue resector. When the motorized resector was used, Ringer’s acetate solution was temporarily used for distending and irrigating the joint.

When there were medial and lateral fragments within the same joint, a lateral instrument portal was made after removal of the medial fragment. The lateral fragment was removed using the original (medial) arthroscopic portal and bringing the tip of the arthroscope to the lateral aspect of the joint (contralateral triangulation). In cases of bilateral fragmentation, rather than roll the horses, ipsilateral or contralateral triangulation was used depending on fragment location. At the end of the procedure, 500–1000 mL of Ringer’s acetate solution was used to irrigate the joint. Portals were closed with a simple interrupted skin suture and a padded half-limb bandage was applied.

**Postoperative Care**

After recovery from anesthesia, radiographic confirmation of OC fragment removal was carried out. No postoperative anti-inflammatory medication was administered. Discharge instructions included 2 weeks of stall rest with a half-limb bandage (changed every 3 days), followed by small-paddock exercise for 4 weeks. After this, horses were allowed free pasture exercise or were returned to training, depending on age and training status.

**Outcome**

Follow-up information was obtained by telephone contact with the owners or trainers 3–24 months after surgery. Information on outcome and any complications was obtained. Specifically, statements on postoperative weight bearing on the operated limb(s) and surgery site swelling were retrieved.

**RESULTS**

Gas distention resulted in a sharp image without villi obscuring the view. Fragments were readily visible and could be easily loosened and removed. In 5 horses, bleeding from the arthroscopic or instrument portal temporarily obscured the operative field during gas distention; however, rinsing the tip of the arthroscope with Ringer’s acetate solution by repeatedly opening and closing the stopcock that regulated the fluid ingress quickly restored visibility. Compared with the visibility obtained during
fluid distention, gas distention subjectively resulted in a sharper image which facilitated fragment identification and removal (Figs 1, 2). However, overall surgical time was not shortened by using gas distention. Some degree, varying from slight to moderate, of intraoperative subcutaneous swelling was observed in all horses. In all but 1 horse, complete fragment removal was achieved. In this horse, a 1 mm × 3 mm radiodense body was observed on postoperative radiographs. None of the horses had signs of lameness or discomfort during convalescence. Six horses had slight swelling of the surgery site on the first postoperative bandage change; however, this resolved and no discharge occurred from the incisions.

**DISCUSSION**

Previous descriptions of arthroscopic approaches for removal of OC fragments of the palmar/plantar aspect of the MCP/MTP joints in horses have reported fluid distention of the joint. It is generally accepted that fragment identification can be difficult because of vili obscuring the visual field at the base of the sesamoid bone.
and, that in some cases, a probe has to be used to confirm fragment location. It is the author’s opinion that removal of these fragments using fluid arthroscopy entails special problems compared with other joints. Specifically, the inability to clearly visualize the entire circumference of the fragment makes surgical manipulation for dislodging the fragment and its removal somewhat difficult. Often, the instruments have to be handled blindly that is without the surgeon being able to see the instrument tip while it is being used for fragment manipulation. Although fragment removal may be carried out quickly despite these difficulties, the surgery may appear less esthetically pleasing than other arthroscopic procedures.

This study confirmed that gas distention, by compressing synovial villi that could otherwise obscure the operative field improved fragment visualization in the palmar/plantar aspect of the MCP/MTP joints, therefore facilitating fragment removal. The only problem identified during gas arthroscopy was occasional bleeding from the arthroscopic or instrument portal, which temporarily obscured the operative field. However, this was easily corrected by repeatedly rinsing the tip of the arthroscope with Ringer’s acetate solution delivered from the fluid ingress line. Incision site bleeding also has been described as a problem during gas arthroscopy of the human knee, causing substantial obstruction of the field of view.

OC fragments of the palmar/plantar aspect of the MCP/MTP joints are one of the few conditions in equine arthroscopy where sharp dissection is necessary. It is the author’s clinical impression that sharp dissection can in some cases lead to inadvertent fragment fracture which results in incomplete removal as occurred in 1 horse in the present study. Incomplete fragment removal should therefore be regarded as a possible inherent technical problem regardless of whether fluid or gas arthroscopy is used. However, it is the author’s opinion that the improved visibility obtained by gas distention probably reduces the risk of incomplete fragment removal.

Gas arthroscopic procedures in humans may lead to complications related to gas leakage from the joint. Gas spreads more readily into the periarticular tissue than fluids, and often forms local emphysema that resolves within hours to a few days. More extensive gas spreading can occur, and postoperative emphysema of the peritoneum, scrotum, mediastinum, and the soft tissues of the neck have been reported. Venous air embolism, a potentially fatal complication that may occur when gas is introduced under pressure into a body cavity, has been reported during gas arthroscopy in humans. Use of CO2 for joint distention substantially reduces the risk of embolism compared with other gaseous media like air or nitrous oxide, because CO2 dissolves into plasma more quickly and so is 5 times less toxic than air as an intravenous embolic agent. Preventive measures include the application of a tourniquet proximal to the joint, or a surgery site location at or below the level of the heart.

In arthroscopic laser extirpation of MCP pad proliferation in horses, gas leakage from the joint was prevented by wrapping the surgery site in a sterile elastic bandage. In the present study, lateral recumbency may have reduced the risk of embolism as this position places the surgery site at or below the level of the heart. No other measures were undertaken to prevent gas leakage. Slight swelling at the surgery site, probably because of periarticular emphysema or inflammation, was noted at the first postoperative bandage change in 6 horses, but other than that, no intraoperative or postoperative complications were observed. It is the author’s impression that the degree of intraoperative subcutaneous swelling that occurred was comparable with those occurring during fluid distention arthroscopic procedures. In none of the horses did subcutaneous swelling significantly impair visibility and fragment removal.

To the author’s knowledge, there are no reports on any recognized differences in postoperative infection rate between gas and fluid distention arthroscopy in humans. In human arthroscopic knee surgery reported incidences of postoperative infection were 0.01–0.23%; however, there was no indication that the distending medium was a risk factor. None of the horses in this study had signs of postoperative joint infection.

Gas arthroscopy with CO2 proved to be a useful technique for removal of OC fragments of the palmar/plantar aspect of the MCP/MTP joints in horses. Compared with fluid arthroscopy, better fragment visualization was the main advantage of this technique.

REFERENCES


