



CORRESPONDENCE AND COMMUNICATION

Water-power: High pressure water jets and devastating lower limb injury

Dear Editor,

We would like to relate three cases of lower limb injury caused by industrial high-pressure water jets, one associated with small bowel injury and one with fractures to the femur, tibia and patella.

High-pressure water jets (HPWJ) have diverse industrial use. With pressures up to 100,000 psi (power–force/sq.inch) generated in a narrow water jet, they can be used to mine granite and cut steel. Features of soft tissue injuries caused by high-pressure water jets have been described by Tejero-Trujeque¹: The surface wound of a HPWJ injury may not reflect the extensive tissue damage beneath, the wound may be widely contaminated by materials driven into the wound, there is a potential for progressive oedema and inflammation, and unusual infections may occur due to micro-organisms in the water source.

Injuries to the airway, major vessels, brain, eyes, viscera and limbs are well reported but there are no documented cases of fracture caused by HPWJ.

Patients and methods

The patients case notes and radiological images were reviewed and patient consent was obtained for use of photographs and radiological images.

Case 1

A 39-year old man was using an industrial HPWJ at 19,000 psi to blast paint off concrete, when the water jet head became disconnected and struck him on the left knee. On admission to hospital he was found to have an extensive laceration to the anterior knee with surgical emphysema tracking into the leg. An X-ray (Figure 1) revealed fractures of the distal femur, tibial plateau and patella. The wound

was explored under general anaesthetic and was found to be grossly contaminated, with cloth embedded in bone and extensive disruption of the patellar tendon. The wound was debrided and a pre-emptive medial fasciotomy of the leg was performed. During a second look procedure on day 3 (Figure 2), the patellar tendon was reconstructed and the anterior knee was covered with a medial gastrocnemius flap. As the patient was resident in another region his care was transferred. We have learned from correspondence that an above knee amputation was subsequently required due to progressive tissue necrosis.

Case 2

A 27-year-old male was using a HPWJ at 19,000 psi when he sustained injuries to his right thigh, abdomen and right index finger. On admission to hospital he was in excruciating pain with palpable crepitis to the right groin and abdominal tenderness. After resuscitation, his wounds were explored under general anaesthetic. He was found to have division of semimembranosus, semitendinosus and disruption of the sciatic nerve. The water jet also entered the abdomen and a litre of blood was identified in the peritoneal cavity and three bowel perforations. The small bowel was repaired, the thigh wounds were debrided and a fractured right index distal phalanx (DP) was fixed. The thigh wound was later grafted. His recovery was complicated by paralytic ileus, which resolved and an abdominal drain-site infection which responded to antibiotics. He developed pain in relation to his sciatic nerve injury but was well enough for discharge on day 13.

Case 3

A 26-year-old male power plant worker was using a HPWJ at an unknown force to clean a boiler. He lost control of the hose and the water jet passed over his legs causing deep lacerations to both thighs. His wounds were explored under General anaesthetic. On the right thigh, he was found to have division of vastus medialis, sartorius, adductor magnus and the saphenous nerve and vein. The suprapatellar bursa was open and the patellar tendon was 30% divided. On the left the patella was exposed. All wounds were debrided. Subsequently he made a steady recovery and was



Figure 1 X-ray of the left knee showing anterior cortical disruption of the distal left femur and tibia with displacement of the patella and diffuse foreign bodies in the soft tissue.

discharged to the community on day 6. When last reviewed he was mobilizing independently with a good active range of movement of his knee.

Discussion

The earliest reports of industrial high-pressure injuries date back to 1960's.²

At this time HPWJ had pressures of approximately 30% of those used in industry today. In the 1980's Calder showed that fluid jet pressures of 2900 psi caused multilayer tissue destruction at close range.³ In the last decade in vitro studies have shown that pressures over 400 bar (5802 psi) are adequate to cut bone.⁴

It is not uncommon for commercial technology to be adapted for domestic use and smaller, industrial replicas are now found in the hands of home-improvement enthusiasts. Although domestic HPWJ are commercially available, their pressures do not exceed 2180 psi and they are far less likely to cause extensive injury than industrial HPWJ.

Water jet technology joined the armamentarium of the surgeon in the 1970's and today it is used for wound and burn debridement and organ resection.⁵ As the use of water jet technology expands in public, industrial and medical

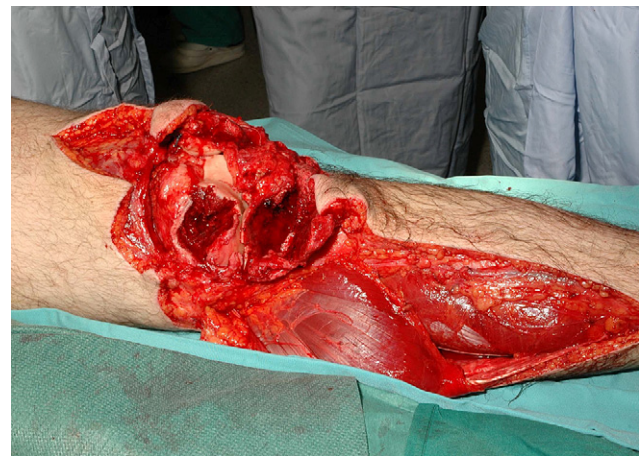


Figure 2 Intra-operative findings during a 'second-look' procedure: Extensive soft tissue disruption of the anterior left knee with cavitation of the distal femur and proximal tibia.

domains, awareness should also grow to prevent and treat these injuries, at home and in the workplace.

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Conflict of interest

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