Plication of patellar tendon with novel technique to lower the level of patella alta in cerebral palsy crouch gait.

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ABSTRACT

Introduction: constant crouch gait is a trouble faced youth with spastic cerebral palsy, characterized by excessive knee flexion throughout stance phase, once the crouch gait reaches a proven level of acuity in the child, the degree of knee flexion and related features may proceed quickly because of high stresses at the knee and failure of the knee extensor mechanism. Knee ache, patella alta, and fragmentation or fracture of the inferior pole of the patella all have been recorded in this clinical setting.

Material and methods: 20 knees (10 patients) diseased with spastic diplegia. All were ambulatory children (GMFCS II and III), they are in crouch gait and patella was alta. Patient age, sex, functional status, associated surgical procedures were reported preoperatively. Extension lag was recorded pre and postoperative. Koshio Index was used to identify the outcomes.

Results: Improvement in extensor lag mechanism from 25.25±10.45 SD to 9.15 ±5.06 after a year follow up, Koshino index mean improved also from 2.47±0.17 after 1 year.

Discussion: The new technique showed good results with minimal complications, safer and less technically demanding than other options.

KEYWORDS: Crouch gait, plication patellar tendon, paediatric, patella alta, Cerebral palsy,

INTRODUCTION

Crouch gait is utilized generically to describe a gait style characterized by enhanced knee-flexion during the attitude stage of the gait cycle [1, 2]. The pattern typically worsens with time without surgery and often leads to pain and decrease walking ability [3, 4]. Interventions are challenging because although the primary description of crouch gait is in the sagittal plane, however other deformities are commonly present [5,6].

Crouch gait is a walking pattern ranging from mild to severe. The definition of ‘crouch gait’ include a criterion of ≥ 20° knee flexion at initial contact and mid-stance and may be associated with dorsiflexion of the ankle (ankle calcaneus). [7] Patella alta and crouch gait are associated .This is due to many factors involving quadriceps impairment or spasticity and hamstring spasticity. [8] In the existence of patella alta, a lowering in the moment arm to stop knee expansion results, just life that further participating to an already weakened extensor mechanism, this data in an inflected knee attitude and excessed stress across the patellofemoral joint and may resulted in  late degenerative changes in this joint.[8] In this
study we are trying to assess the effectiveness of one surgical technique of patellar tendon plication in improving the quality of gait and decreasing the energy expenditure during gait movement of cerebral palsy patients.

PATIENTS AND METHODS:

A case series study was done on Spastic cerebral palsy patients with crouch gait. In this study, 60 limbs in 30 diplegic patients with crouch gait and patella alta were treated by hamstrings release with or without supracondylar femoral osteotomy and patellar tendon plication.

Follow up period was for a minimum 6 months. We included ambulatory spastic cerebral palsy patients with crouch gait and GMFCS II and III. We excluded non ambulatory spastic cerebral palsy patients, crouch gait without patella alta, GMFCS IV and V, ankylosed or septic knee and mixed CP types. Evaluation of all patients was done by history taking including personal data including family history and consanguinity, present, perinatal, developmental, medical and surgical history. Assessing of handedness, irritability, awareness, oromotor malformations (nutrition problems, poor sucking or swallowing, and drooling). Inspection and palpation of previous scars and site of patella and measuring hips, knees and ankles range of motion, popliteal angle and extension lag. Developmental milestones were examined followed by neurological and visualized gait examination assessment. Plain x-ray: A-P & lateral views of both knees were done preoperatively. Routine pre-operative labs were performed .All patients underwent anesthesia consultation and consented about the surgery, possible risks, complications and follow up protocol. Anesthesia was general except in the presence of a contraindication, regional anesthesia was used (in two patients due to bad chest condition). 1gm of cefazolin was given one hour before incision. Tourniquet was applied as high as possible and the position was supine. The image intensifier passage and position were planed ahead, images are taken. Before draping to ensure that proper intra-operative images can be taken .Operative time, blood loss and perioperative blood transfusion, intraoperative complications were documented in the patient notes.

Surgical technique:

A 4 cm longitudinal or transverse incision is performed (2 cm above patellar superior pole) .Rectus femoris tendon is released by pie crusting technique. (Figure 1). A polyester is used to make a transverse suture at the distal end of the rectus tendon leaving two equal free ends from the tape. (Figure 2) A 5 cm longitudinal incision is made at the medial aspect of tibial tuberosity. A passing pin is used to deliver both free ends of the tape inferior to the tibial tuberosity opening through medial and lateral patellar retinacula substance . (Figure 3). A 3.2 mm drill bit is used to do a transverse tunnel below tibial tuberosity (Figure 4). Using the passing pin to pass the medial end to the lateral one through the transverse tunnel (Figure 5). Both ends are tracted till reaching the optimum patellar height (Figure 6). We check patellar position using the image intensifier. Both ends are tied over the lateral aspect of tibial tuberosity. (Figure 7) .Above knee full extension cast is performed postoperatively.
RESULTS:
Operative time ranged from 1-2 hours with mean 1.9 ±0.50 SD. And blood loss ranged from 20-70 cc with mean 45 ± 19.67 SD. Complete union was achieved within 4 months. All patients remained in the same GMFCS scale postoperative. Koshino Index improved from 1.50±0.20 SD to 1.12 ±0.15 SD and remained at 6, 12, 24 weeks and after 1 year with P value =<0.001 and Popliteal angle also improved from 69.0±7.71 SD to 34.75±11.97 SD. Extension lag improved from 30.75±10.45 SD to 9.15 ±5.06 after 1 year follow up Complications were (by limb) in the form of traction neuropathy was 2.5% , relapsed patellar position was 5% and infected wound was 5%.

DISCUSSION:

The philosophy for surgical decision-making is to restore straight attitude and the plantar flexion/knee extension couple (SEMLs) in one stage in most of series cases, other procedures were performed simultaneously with patellar tendon advancement procedures.

It is mandatory to correct both the static fixed knee-flexion contracture and the dynamic quadriceps (patellar tendon) insufficiency to improve persistent knee flexion in attitude stage and full knee flexion during swing stage. The concomitant procedures were achieved in our participants were coordinated with the overall bases of lengthening contracted musculotendinous units that limit the range of movement and correcting lever-arm dysfunction to optimize muscle performance and they could have accounted for some of the amendment in the gait styles. Improvement in lower limb function and crouch gait were noticed (minimum flexion in stance phase) as well improvement in lower limb deformities. Improvement in walking ability with lesser needs for walking support but this improvement was in the same GMFCS scale. meanwhile, all knees were included in this study and underwent patellar tendon plication surgery as a part of SEMLS showed improvement in their position as regards Koshino index and showed improvement of crouch gait with a greater improvement in knee position in stance phase and resolution of knee soft tissue flexion contracture and lower limb angular and rotational malalignment. This was a clear and evident by visual observation after 6 months interval follow up. In our series, the patellar position improved in all knees and remained at 6, 12, 24 weeks and after 1 year with regardless of the concomitant procedures performed which is in agreement with the study of Stout et al. [9] and Das et al. [10] As regards extension lag, the study group had shown marked improvement in extension lag in comparison to preoperative extension lag which complies with the study of Stout et al. [9], Rodda et al. [11] and Sossai et al. [12]. All patients improved clinically and radiologically but remained in the same GMGCS scale, GMFCS of patients included in the study didn't affect clinical and radiological improvement in statistically significant way which complies with study of Novacheck et al. [13]. Regarding complications, traction neuropathy was recorded in 1 patient (2.5%) in our study which is less than Stout et al. [9] who recorded 3 patients (6.1%) , complete nerve recovery occurred without intervention after 4 months. Relapsed patellar position was reported in 2 limbs (5%) in two patients. After revision surgery, he made an acceptable recovery and the result of his walk was satisfactory. Sossai et al [12] also reported failure of their technique in 4 limbs (7.4%). Infection as a complication of this surgical technique was observed in 2 limbs (5%) in one patient which was managed by surgical debridement. Sossai et al. [12] also reported 2 (3.7%) limbs infected with irrigation and debridement procedure. In addition, Tageldeen et al. [14] Novacheck et al. [13] cleared the significance of patellar tendon improvement to confirm optimal data in the operative management of a persistent crouch gait. In his investigation (73 persons), divide them into 3 groups, (1) a distal femoral extension osteotomy in combination
with a distal patellar tendon development (thirty-three individuals), (2) a distal femoral extension osteotomy without patellar tendon development (16 individuals), or (3) a distal patellar tendon development only (24 individuals), all of the investigation population reported advancement in Koshino index but with a greater rate of over correction. Their technique is technically demanding and in skeletally immature patient group, it carried risk of tibia tubercle apophysis injury as they detach patellar tendon from its insertion then reinsert in a periosteal sleeve compared to our study that uses a simple, easy to do and safe technique. They depended on knee kinematic measurements by gait analysis to assess its study population improvement, in our study we didn’t use kinematic measurements due to limitation in availability of gait labs. Improvement in the Koshino index from 1.34 pre-operatively to 1.10 post-operatively, but this study used knee kinematic measurements during gait as gait variable score and gait profile score (by gait analysis) as a measurement rather than extension lag test, but this technique also carried a risk of tibial tubercle apophysis injury and technically demanding as it adopted splitting of patellar tendon in the sagittal plane and from its distal insertion. Tageldeen et al. [14] used different technique in treatment of patella alta in patients with spastic cerebral palsy applied on 10 patients (20 knees) depending on dealing with patellar tendon without stripping tendon insertion to avoid tibial tubercle apophysitis. They showed improvement in Koshino index, extension lag and functional limb performance.

CONCLUSION

We estimated the management of persistent crouch gait, patella alta using the recommended operative technique that repositioned patella and correct knee extensor insufficiency. The results suggest patellar tendon plication by using this technique in patients below skeletal maturity age is with good results, minor complications, not high technically demanding procedure, The study suggests that the procedure is safe (tibial apophysis remains untouched) and successful. Because abnormality is less prospective to repeat in persons in whom the growth rate has delayed (adolescents), it seems reasonable to expect that these pubescent's will be able to preserve gait ability into puberty. So we suggest that patellar tendon plication using this technique is a useful intervention in the management of adolescent crouch gait. Patellar position, Knee function and walking ability improved after surgery and the technique has been found to be safe and effective. The current investigation was restricted by lack of postoperative kinematic estimation using gait lab. It is also limited by the short duration of follow up (18 months), which secluded the effects of surgical interference to a period setting that allowed the persons to recover but reduced the covariate influences of growth and other variables. In addition, it is limited by the fact that it was not a randomized controlled trial and the sample size was small. In the near future, we are looking for bigger sample sized population, longer duration of follow up with using knee kinematic measurements by gait analysis preoperatively and postoperatively.

REFERENCES: