

## Tibialis Posterior Transfer for Foot Drop: Difference in Outcome for Two Different Attachment Sites

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### ABSTRACT

**Objective:** To compare the outcome of Posterior Tibialis tendon transfer to two different attachment sites in terms of post-surgery dorsiflexion strength.

**Study Design:** Quasi-experimental study.

**Place and Duration of Study:** Department of Plastic Surgery, Combined Military Hospital, Rawalpindi Pakistan, Jul 2020 to Jul 2021.

**Methodology:** We studied a total of 30 patients who developed Common Peroneal Nerve palsy. Patients with previous surgery, especially those with posterior tibialis tendon transfer were excluded. Patients were divided into two equal groups of 15 patients each, with Group-A receiving surgery with the modified Barr's technique while Group-B received classic Barr's technique. All participants were followed up at six months for degree of ankle dorsiflexion, varus deformity and hypercorrection.

**Results:** None of the cases which underwent modified Barr's technique developed varus deformity, as opposed to 4(26.7%) cases with the classic technique ( $p=0.032$ ). For hypercorrection, no cases were seen with the modified technique versus 5(33.3%) cases with the classic technique ( $p=0.014$ ). All cases with the modified technique developed some improvement in active dorsiflexion with 14(93.3%) achieving normal range, while 12(80%) showed some improvement with the classic technique and only 7(46.7%) acquired normal range ( $p=0.018$ ).

**Conclusion:** The modified Barr's technique was superior to the classic Barr's technique for posterior tibialis transfer in cases of foot drop in terms of functional outcomes.

**Keywords:** Attachment site, foot drop, tibialis posterior transfer.

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### INTRODUCTION

The Common Peroneal nerve is a branch of the sciatic nerve, from which it separates just proximal to the popliteal fossa, and runs laterally to hook around the fibular neck.<sup>1</sup> Palsy is very common in patients with injury around the knee, due to direct blunt or penetrating trauma or even lacerations.<sup>2</sup> The nerve is particularly susceptible to palsy where it curves around the fibular neck, making it prone to injuries affecting the lateral aspect of the knee,<sup>3</sup> estimated to be about 4.5% to 40% of cases.<sup>4,5</sup> Common Peroneal Nerve palsy presents with weakness of ankle dorsiflexion, resulting in the toes "catching" when the patient tries to walk, or it may manifest as foot drop which can occur immediately or a few weeks after the inciting event. It may be complete or partial, with associated pain, numbness or paresthesia along the lateral leg and dorsum of the foot.<sup>6</sup>

Conservative management involves braces and splints to assist movement as well as rehabilitation

physiotherapy, in which muscle strengthening and stretching is achieved with the use of ankle-foot orthotic devices help with toe dorsiflexion during walking and provide stability when standing.<sup>7,8</sup> Patients may be offered surgical treatment if there is no improvement in the clinical state within initial 90 days or direct nerve laceration, amenable to repair, is suspected.<sup>9</sup> The classic Barr's technique involves the de-attachment of the posterior tibialis tendon from the navicular bone and its reinsertion at the base of the second or third metatarsal, or the second or third cuneiform bone. The modified Barr's technique involves reinsertion of the tendon into the cuboid bone.<sup>10</sup>

Common Peroneal Nerve palsies are common and are associated with significant but potentially correctable disability. Various methods, both conservative and surgical, have been described for management in literature with equally variable results as the optimal site of insertion remains a subject of debate. This study was conducted to determine which site of reinsertion provided that best post-operative results in terms of degree of foot dorsiflexion, as well

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as the development of post-operative complications such as varus deformity and hyper-correction.

**METHODOLOGY**

The quasi-experimental study was conducted from July 2020 to July 2021, at the Department of Plastic Surgery, Combined Military Hospital, Rawalpindi, Pakistan, after gaining approval of Ethics Committee (IERB letter number 188/07/21). The WHO sample size calculator was used to calculate the sample size keeping the population standard deviation ( $\sigma$ ) of 4.715, population variance ( $\sigma^2$ ) of 22.231225, test value of the population mean of 82.75 and anticipated population mean of 91.00.11

**Inclusion Criteria:** Patients aged 20-65 years, with ASA Class-I to II, of either gender, with diagnosed and irreparable common peroneal nerve palsy with loss of active dorsal flexion and functional range of motion of the ankle were included.

**Exclusion Criteria:** Patients who had received previous surgery for repair of common peroneal nerve palsy with tibialis posterior transposition, or those with an ankle deformity were excluded.

We enrolled 30 patients diagnosed with foot drop, through non-probability consecutive sampling, after taking informed consent. Diagnosis was confirmed by electromyography before the procedure. Patients were divided into two equal groups with Group A undergoing surgery with the modified Barr’s technique, and Group B receiving the classic Barr’s technique (Figure). All surgeries were performed by a consultant surgeon with a minimum of 5 years post-fellowship experience, who was blind to the objectives of the study. Patients were given spinal anaesthesia. An oblique incision of about 5 cm was made along the medial plantar side over the tuberosity of Navicular bone. The tendon was disinserted and raised through a second incision on the medial side of the tibia, followed by a window formation through the interosseous membrane of tibia and fibula. The insertion site was then exposed, depending on the technique. A hole was made in the middle of the target bone. The tendon was then sutured using a fiber wire number 2. With the fibers pulled through to the other side and held with ankle in dorsiflexion, an absorbable screw was used to hold the tendon in place, which was followed by closure of the skin. A plaster was kept in place for two months, followed by removal and physiotherapy. Final evaluation was done at six months. Post-operative results were evaluated by the degree of active dorsiflexion achieved, the presence of

varus deformity and hypercorrection of the foot. Patients with a degree of dorsiflexion from 15° to 20° were considered normal, those with an angle between 1° and 14° were considered subnormal, while no dorsiflexion was termed none.

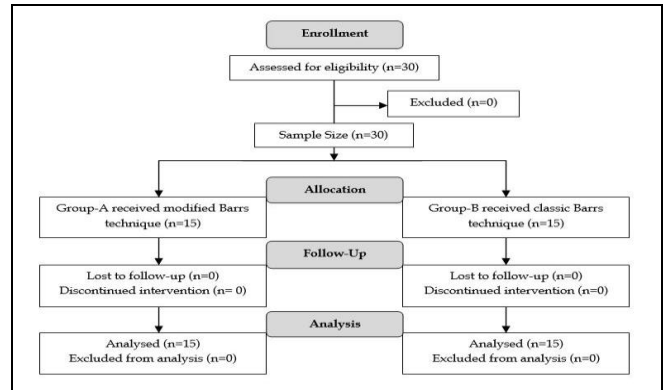


Figure 1: Patient Flow Diagram (n=30)

Data was analyzed using SPSS version 26.00. Mean and SD was calculated for quantitative variables. Qualitative variables like gender, etiology of common peroneal nerve palsy, the presence of varus deformity, and presence of hypercorrection of the foot were recorded in terms of frequency and percentage. Chi square test was applied to qualitative variables for comparison, while independent samples t-test was applied to all quantitative variables and *p* value of  $\leq 0.05$  was considered significant.

**RESULTS**

A total of 30 patients were studied, of whom 23(76.7%) were male. The mean age of the sample was 33.47±8.16 years. The most frequent cause of Common Peroneal Nerve palsy was trauma (23, 76.7%), while entrapment and tumours accounted for 6(20.0%) and 1(3.3%) cases, respectively. Data for pre-surgery patient characteristics is shown in Table-I.

Table-I: Pre-Surgery Patient Characteristics (n=30)

| Characteristics | Group-A (n=15) | Group-B (n=15) | <i>p</i> value |
|-----------------|----------------|----------------|----------------|
| <b>Gender</b>   |                |                |                |
| Male            | 11(73.3%)      | 12(80.0%)      | 0.666          |
| Female          | 4(26.7%)       | 3(20.0%)       |                |
| Age (years)     | 31.60±8.23     | 35.33±7.93     | 0.216          |
| <b>Etiology</b> |                |                |                |
| Trauma          | 12(80.0%)      | 11(73.3%)      | 0.593          |
| Entrapment      | 3(20.0%)       | 3(20.0%)       |                |
| Tumor           | -              | 1(6.7%)        |                |

A total of 4(13.3%) developed a varus deformity post-surgery across both groups. Hypercorrection was seen in 5(16.7%) patients. Dorsiflexion was normal in 21(70.0%) patients, subnormal in 6(20.0%), and absent in 3(10.0%). Results for post-surgery evaluation, divided by groups, are shown in Table-II.

**Table II: Post-Surgery Patient Characteristics (n=30)**

| Characteristics              | Group-A (n=15) | Group-B (n=15) | p value |
|------------------------------|----------------|----------------|---------|
| <b>Varus Deformity</b>       |                |                |         |
| No                           | 15(100%)       | 11(73.3%)      | 0.032   |
| Yes                          | -              | 4(26.7%)       |         |
| <b>Hypercorrection</b>       |                |                |         |
| No                           | 15(100%)       | 10(66.7%)      | 0.014   |
| Yes                          | -              | 5(33.3%)       |         |
| <b>Angle of Dorsiflexion</b> |                |                |         |
| Normal                       | 14(93.3%)      | 7(46.7%)       | 0.018   |
| Subnormal                    | 1(6.7%)        | 5(33.3%)       |         |
| None                         | -              | 3(20.0%)       |         |

Modified Barr's technique appeared to have a lesser incidence of varus deformity or hypercorrection and an improved dorsiflexion, post-operatively, with *p* values of 0.032, 0.014 and 0.018, respectively.

## DISCUSSION

Foot drop can occur because of a wide variety of causes, but in our study the most common cause was trauma. This results in direct external compression of the nerve, internal disruption by a displaced knee fracture, or it can result from a rapidly expanding haematoma causing nerve injury and compression. Trauma was also the most common cause encountered in another study.<sup>12</sup> Various repair methods have been described in literature with erratic success.<sup>13</sup> We aimed to evaluate the Modified Barr technique which, to date, has only been compared to the classic technique in one study.<sup>11</sup> Our study found no relationship between gender and adverse outcomes or with age, although there was a preponderance of males in our sample, a finding that was also demonstrated by Yeganeh *et al.*<sup>14</sup> This finding may be attributable to differences in professional and social or cultural activities between males and females, leading to a male propensity to trauma.<sup>15</sup> Our study demonstrated that the rate of normalization of dorsiflexion was higher with the modified Barr's procedure where 93.3% of patients recovered full range of dorsiflexion as compared to 46.7% with the classic technique. In addition, there were no cases of varus deformity or hypercorrection, which was also at odds with the results in the classic technique group. These findings were consistent with

Salihagić *et al*, who reported similar findings.<sup>11</sup> Breukink also conducted a study using the classic technique and found that 50% of patients recovered some degree of dorsiflexion, which was consistent with our results for the classic technique.<sup>16</sup>

Common Peroneal Nerve palsy associated foot drop is difficult to manage as the muscles providing plantar flexion are more numerous than the ones causing dorsiflexion, thus while walking, the toes tend to "drop" and drag along the ground leading to a walk known as the high stepping gait where the patient purposefully lifts the ankle by flexing the hip higher to prevent dragging.<sup>17,18</sup> To treat this, the tibialis posterior tendon is transferred anteriorly to provide flexion during the swing period of walking.<sup>19</sup>

Tendon transfers, like all surgical procedures, are not without complications, which can include continued or new deformities such as hyperdorsiflexion, varus deformity, failure of correction (due to less tension in the tendon), as well as spasticity, persistent pain, surgical site infections and abscesses. Nerve injury can also occur in Tarsal Tunnel Syndrome leading to paresthesia and intractable neuropathic pain.<sup>20</sup> In addition, adhesions can occur secondary to the procedure resulting in a reduced movement range, requiring further surgery.<sup>21</sup> Redirecting the posterior tibialis tendon anteriorly reduces the degree of foot drop, with resultant improvement in gait. The modified technique also has a less incidence of post-operative deformities associated with it as compared to the classic technique.

Selection of the appropriate patient is paramount for optimal results, and rehabilitation, physiotherapy and gait therapies play an important role in improving functional outcomes, requiring a multidisciplinary approach for these patients. As such, it may be employed in preference to other procedures for the management of irreparable common peroneal nerve palsy.

## LIMITATION OF STUDY

Our study had a follow-up period of six months which only looked at short-term functional outcomes and complications. It was also limited by a small sample size and was a single-center study. Furthermore, the observer was not blind to the objectives of the study. Additional research is required to compare the modified Barr's technique to other tendon transfer techniques to provide definitive data.

## CONCLUSION

The modified Barr's technique is associated with better functional outcomes as compared to other techniques,

especially in terms of improved dorsiflexion with an associated reduced incidence of varus deformity and hypercorrection of the foot.

**Conflict of Interest:** None.

**Authors Contribution**

Following authors have made substantial contributions to the manuscript as under:

SF & SH: Data acquisition, critical review, approval of the final version to be published.

AM & FM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TS & AA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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