

EARLY TENOTOMY OF TIBIALIS POSTERIOR AND ACHILLES TENDONS IN THE MANAGEMENT OF CONGENITAL TALIPES EQUINOVARUS (CTEV)

THESIS

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APPROVAL

This dissertation by Jabbin Longa Mulwanda has been approved as fulfilling part of the requirements for the award of the Master of Medicine Degree (in Surgery) by the University of Zambia.

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ASST DEAN (POSTGRADUATE)

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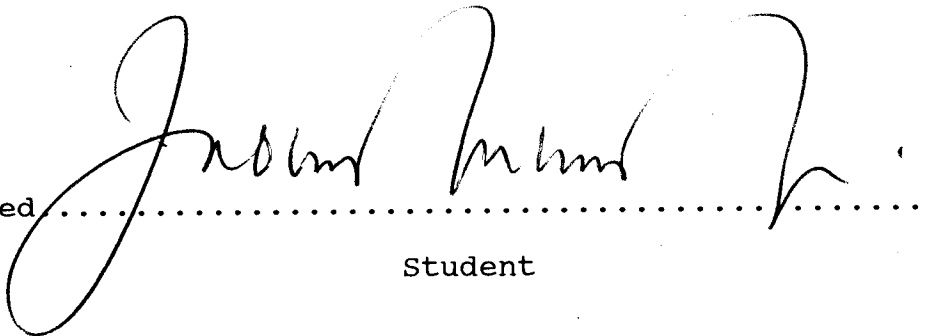
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Lastly thanks to Eddie and Jackie

DECLARATION

I hereby declare that the work presented in this study for the Degree of Master of Medicine (General Surgery) has not been presented either wholly or in part for any other degree and is not being currently submitted for any other degree.

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Student

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Supervisor

SUMMARY

This is a prospective study carried out in the Orthopaedic Unit of the Department of Surgery at the University Teaching Hospital.

The aim was to determine the effects of tenotomy of the tendons of tibialis posterior and Achilles in the correction of clubfoot which had resisted non-operative correction by the third month of life.

The results showed that the procedure under consideration produced good results in 72% of the cases and complications were rare. It is therefore recommended for use even at the district hospital level, as long as consistent follow-up can be ensured.

INTRODUCTION

Congenital Talipes Equinovarus (CTEV), also called clubfoot is the most common limb anomaly requiring surgical correction. It is also the most common congenital musculoskeletal malformation (Bahadur and Bhat, 1989; Ickler and Kessi, 1986).

The incidence is generally quoted as 1 - 2 per 1000 live births. Some authors in Africa believe that the incidence may be higher than that of Europe and North America Ickler and Kessi, 1989; Parekh, 1970; Porter, 1982; Workman, 1979).

Bahadur and Bhat found a significantly higher incidence of severe CTEV among children of parents with a low socioeconomic status. This may well explain the impression of a higher incidence in some African studies as compared to that observed in Europe and North America.

Congenital Talipes Equinovarus is a complex deformity which is difficult to treat. The variety of operations advocated is testimony of the fact that none of them is completely satisfactory.

Aetiology

The mild type of clubfoot which is easily correctable is considered to be due to the position of the foot during intrauterine life. Indeed it has been shown that the natural position of the embryonic foot resembles talipes equinovarus at about the 8th to 10th weeks (Ippoplito and Ponseti, 1980; Kwashima and Utholf, 1990). Neuromuscular defects have been investigated (Attenborough, 1966) and so have genetic factors (Handelsman and Badalamente, 1981; Macnicol, 1994; Swart, 1993). Recent work in South Africa suggests a viral aetiology (Swart, 1993).

Pathology

CTEV arises very early in intrauterine life and even at birth the skeletal elements are already deformed and small (Ippoplito and Ponseti, 1980; Irani and Sherman, 1963). It seems that the foot fails to pronate and is possibly held by the tethering effect of the tibialis posterior and Achilles tendons (Attenborough, 1966; Workman, 1979). Although the tight tendons may be secondary to the clubfoot deformity they prevent correction by manipulation (Attenborough, 1966; Workman, 1979).

More recent studies in South Africa suggest that these tendons may in fact be the primary tethers and other ligamentous and bony deformities secondary (Swart).

The ligaments of the posterior, medial and plantar aspects of the foot are shortened. In addition, the muscles and tendons of the tibialis posterior, gastrocnemius and soleus, flexor hallucis longus and flexor digitorum longus are shortened (Attenborough, 1966; Beatson and Pearson, 1966; Workman, 1979). Clinically there are four positional components of the deformity, namely equinus, varus, adduction of the forefoot, and cavus (Brashear and Beverly, 1978; Clark, 1976; Ponseti, 1992).

The aim of treatment is to correct the various deformities so as to achieve a functional, pain-free, plantigrade foot which has good mobility and no calluses. There should be no need for modified shoes (Cumming and Lovell, 1988; Ponseti, 1992).

Conservative management

Most orthopaedic surgeons agree that the initial treatment of clubfoot must be non-operative (Attenborough, 1966; Beatson and Pearson, 1966;

Cowell, 1985; McGowan, 1985). Such methods include manipulation and serial plaster of Paris casts, or stretching and adhesive strapping followed by maintenance of the correction in a Dennis-Browne Splint.

It has already been noted (Attenborough, 1966) that the tight tendons of the tibialis posterior and triceps surae prevent correction by manipulation (Workman, 1979). Manipulative treatment in these circumstances is found to deform the fragile cartilaginous precursors of the foot bones (Attenborough, 1966; Main, 1977; Ponseti, 1992).

Any apparent correction will be achieved by compression of the cartilage models and delicate trabeculae of the tarsal bones resulting in spurious correction (Attenborough, 1996; Harrold and Walker, 1983; Main, 1977). This will lead to unequal growth and a distorted foot. These same tight tendons will continue to act as tethers, so tending to increase the deformity and stiffness.

Persistence with non-operative treatment will result in the complications of rocker-bottom foot, longitudinal arch breach, flattening of the dome of the talus, lateral rotation of the ankle joint and

increased joint stiffness (Attenborough, 1966; Harrold and Walker, 1983; Ponseti, 1992).

Operative treatment

Some authors have advocated early operative treatment (Attenborough, 1966; Harrold and Walker, 1983). Recorded complications include wound infection, skin necrosis, severe scarring, over- correction, under- correction, dislocation of the navicular, flattening and beaking of the talar head, talar necrosis and weakness of the plantar flexors of the ankle joint with major gait disturbances (Ponseti, 1992). In our hospital, Parekh (1970) found a high incidence of wound breakdowns, although this was not related to whether or not correction was affected.

Recurrence of the deformity occurs frequently if major surgery is performed before the child is able to walk. It will be noted that children in Africa are usually carried on their mothers' backs and the feet hang in an equinovarus position. The 'crawler' stage also tends to place the foot in this same position. Furthermore, extensive surgery in the very young is difficult to perform without damaging the tarsal joints; causing later stiffness of the ankle and foot

joints. Above all, there are no long term follow-up results available to suggest that extensive surgery has any added benefit when conservative means have failed (Ponseti, 1992).

Series in Africa and elsewhere reveal a relapse rate of up to 50% after operative treatment of CTEV (Main, 1977; Parekh, 1970; Ponseti, 1992). It is suggested that the difficulties of long treatment regimens and follow-up, and the high proportion of severe CTEV deformities encountered in Africa, are responsible for this (Mc Gowan). On the other hand, some authors in America have claimed up to 90% success with manipulation, serial plaster of paris casts and limited surgery which includes tenotomy of the Tendo Achilles and transfer of anterior tibial tendons (Ponseti, 1992).

AIMS

Considering the finding of a tight Tendo Achilles and the tendon of tibialis posterior in most cases of CTEV, this study set out prospectively to determine the effect of tenotomy of these tendons in the continuing conservative treatment of the clubfoot deformity.

RATIONALE OF THE STUDY

Because the tendon of the tibialis posterior muscle and the combined tendons of the soleus and gastrocnemius muscles (Tendo Achilles) seem to be the primary tethers blocking the manipulative reduction of the deformity, it had become the practice in the Orthopaedic Unit at the University Teaching Hospital to section these tendons in some children, where clubfoot had not been corrected by non-operative means, at about the 3rd month of life. Correction was then obtained by repeated gentle manipulation and plaster casting. This correction was maintained by splintage for about a year, by which time the child is expected to start walking.

There had been some successes with the operation but also some failures which needed further surgery. A controlled trial with careful attention to the possible causes of failure was found necessary to determine whether this is an operation which should be done more often. It was hoped that this operation which is simple and quick to perform may prevent the severe crippling of neglected or recurrent clubfoot so often seen in Zambia by making effective treatment possible by general duty Medical Officers.

At present, definitive surgery for CTEV is a long and complicated procedure performed effectively by a few orthopaedic surgeons in Zambia and only available to those few children within reach of the specialist hospitals.

PATIENTS AND METHODS

This was a prospective study carried out in the Orthopaedic Unit of the Department of Surgery of the University Teaching Hospital in Lusaka. The hospital caters for a population of nearly 2 million people.

The study period was 2 years beginning January, 1994. For ease of follow up only Lusaka residents were included. Subjects were children presenting to the Orthopaedic Clinic with a diagnosis of severe congenital talipes equinovarus (CTEV) at ages below 2 months.

At initial presentation, a full clinical examination to exclude other musculoskeletal abnormalities was done.

The severity of the deformity was clinically assessed by noting the following:

- Estimated angle of varus, equinus and adductus
- Presence and depth of the heel crease, tarsal crease
- Mobility

The severity was graded as either mild, moderate, severe or very severe (Appendix I). Only the severe and very severe grades were recruited to the study. The clinical information was then recorded on a proforma (see appendix I)

Non-operative treatment

If the child was less than three months old maternal manipulation or manipulation with serial plaster casts was advised, depending on whether casting was feasible. At the age of three months the feet were then reassessed. If insufficient correction had been achieved based on the classification shown in appendix II, tenotomy was advised and undertaken with the parents' informed consent.

The Operation

Following exanguination, a tourniquet was applied and tenotomies were performed via longitudinal incisions over the medial aspect of the tendo Achilles and over the posterior border of the medial side of the tibia about 3cm above the ankle joint. In this way it was hoped to avoid scarring in the area through which further surgery would have to be performed should the need arise. An assessment was then made of the correction achieved. Wound closure was done in layers with 3.0 chromic catgut to the deeper tissues and Nylon 4.0 to the skin. An above knee Plaster of Paris slab was applied. The operations were done by the author.

Follow-up

At two weeks the initial plaster of Paris Slab was removed, the wounds cleaned and sutures removed. Manipulation under anaesthesia was done and a complete above knee cast applied with the knees at 90° flexion and the ankle in external rotation. Signs of a tight plaster cast were explained to the mothers who were told to return to the hospital if these occurred.

Children were then followed up in the clinic with further manipulations and plaster casts at two-weekly intervals until full correction was obtained. Thereafter the casts were replaced at four-weekly intervals to hold the correction while the bones and joints adapted.

Assessment of the outcome was made at 3, 6 and finally at 12 months and the final outcome graded as either excellent, good or failure. This assessment was performed by the author.

The one most important test of success was a child walking on a plantigrade foot.

RESULTS

A total number of 46 patients with severe CTEV had been recruited at the end of 24 months.

Of these 32 patients had bilateral deformities and 14 were unilateral. This represented 78 feet.

There were 37 male patients and 9 females which gives a male to female ratio of 4:1.

Table 1: Number of cases recruited

	Patients	Feet
Bilateral	32	64
Unilateral	14	14
Totals	36	78

Severity

Twenty-seven feet were severe and 51 very severe according to the estimated angle of the deformity as shown in appendix I.

Table 2: Severity of the club foot deformity

	Feet	Percentage
Severe	27	35%
Very severe	51	65%
Total	78	100%

Of the 78 feet a plantigrade attitude was achieved in 60 at operation, representing 76.9%

Final assessment

Final assessment was made in those patients who had completed 12 months or more of follow-up from the time of operation.

There were 30 patients (65%) and 53 feet (68%) in this category. The mean follow-up period was 16 months.

Table 3: Number of cases completing 12 months follow -up

	Patients	Feet
Bilateral	23 (50%)	46 (59%)
Unilateral	7 (15%)	7 (9%)
Total	30 (65%)	53 (68%)

(Figures in brackets represent percentage of the original number of patients recruited)

Outcome

From the 30 patients completing 12 months follow-up, 18 feet in 10 patients were graded as excellent (see appendix iv) and this represented 34% of the feet assessed.

A good result was achieved in 13 feet in 9 patients or 25% of the feet.

Failure was recorded in 12 feet (8 patients) which was 23% of the feet assessed.

Ten feet from five patients were not available for final assessment. All of these had shown good correction at their last review. As a result of these patients lost to follow up a total of 43 feet were assessed, 81% of those completing a 12 month follow up.

An excellent or good result was regarded as satisfactory outcome. This occurred in 31 feet; 72.1% of cases.

Table 4: Outcome

Result	Patients	Feet	Percent
Excellent	10	18	34
Good	9	13	24
Failure	8	12	23
Lost to follow-up	5	10	19
Total	32*	53	10

*The number of patients (32) is as a result of mixed results in some bilateral cases.

Table 5: Relationship between severity and outcome

Severity	Feet	Satisfactory outcome	Percentage
Severe	11	10	90.9%
Very severe	32	21	65.6%
Overall	43	31	72.1%

Of the 43 feet analysed for final outcome, 11 were graded as severe and 32 very severe.

Ten out of the 11 severe feet and 21 out of the 32 very severe feet had a satisfactory outcome representing 90.9% and 65.6% respectively.

Possible factors contributing to failure of correction

The 12 failures of correction were analyzed for possible reasons as shown in table 6. It should be noted that all of these cases had an improved position.

Table 6: Possible factors contributing to failure of correction

Factor	Feet	Percentage
Residual Deformity after surgery	11	92%
Very severe Deformity	11	92%
Poor compliance	6	50%
Complications of treatment	1	8.3%
Skin infection precluding plaster cast	1	8.3%

The severity of the deformity appears to be an important factor. It was the very severe cases which had a residual deformity following tenotomies of the tendons.

Poor compliance was also a factor in half of the failures. In almost all cases it was due to socioeconomic reasons, such as lack of transport money.

Two patients developed conditions necessitating discontinuation of plaster casts.

It was also noted that by the sixth week the tendo Achilles had healed.

In those feet that required further surgery tibialis posterior tendon had also healed or was tethered to the posterior aspect of the tibia.

Thus the primary tethers may become re-established causing loss of correction.

In particular, the rapid healing of the tendon Achilles emphasises the need for continued splintage until the child is able to weight bear.

Complications

One complication as a direct result of treatment was recorded. This was a pressure sore on the dorsum of the foot due to a tight plaster cast. Probably the cast had been applied in equinus and then dorsiflexed causing a fold of plaster across the anterior aspect of the ankle.

No wound infection was recorded.

DISCUSSION

Congenital Talipes Equinovarus of the severe variety is common. It is not possible from this study to give the exact proportion because not all cases of CTEV were included. Furthermore, the late presenters were eliminated and these form a large proportion of severe cases in many African series (Ickler and Kessi, 1989; Parekh, 1970; Sterneberg 1986, Workman, 1979). Parekh, 1970 reported that only 46% of his patients were seen before 3 months of age. At a central hospital in Malawi (Sterneberg, 1986) only 39% of severe clubfoot were seen within the first month of life, the rest presenting later. Similar figures have been reported from Tanzania (Ickler and Kessi, 1989) where 44% of patients presented after 3 months of age.

The male to female ratio of 4:1 is in agreement with the generally accepted view that severe CTEV affects males more frequently than females. This ratio, however, has been greatly influenced by the same shortcomings as discussed above. The same can be said about the proportion of unilateral to bilateral cases which falls within the established ratio.

Of the total 78 feet, 77% were corrected to the neutral position at operation. This confirms our impressions and those of others, as to the importance of the tight tendons of tibialis posterior and the triceps surae (Atteneborough, 1966; Workman, 1979). These tight tendons must be divided if correction by manipulation is to be achieved without damage to the largely cartilaginous foot bones. This is an opportunity for the physiotherapist to maintain the reduction.

The results obtained at operation were an encouragement to the mothers and it may have improved compliance, which was a problem in many series (Ickler and Kessi, 1986; Macnicoi, 1994; Parekh, 1970; Schumauch and Maholela, 1995; Sterneberg, 1986; Workman, 1979). The 19% patients lost to follow-up is much less than the 43.3% reported by Sterneberg (Sterneberg, 1986). However, several factors are involved, both economic and social, which make comparison between two countries or hospitals difficult.

The seventy two percent (72%) excellent or good results in this study are most encouraging considering the simplicity of the operation under consideration. The result has undoubtedly been affected by the 19%

(10 feet) lost to follow-up as all of them had good correction at their last review.

If the patients who, for one reason or another, required discontinuation of splintage and those who did not comply with the treatment protocol are excluded, the success rate rises to 89%. This is comparable to the results obtained by those who advocate physiotherapy with limited early surgery (Atteneborough, 1966; Ickler and Kessi, 1986; Ponseti, 1992).

Ten out of 11 (91%) feet in the severe category were corrected but only 21 out of 32 of the very severe ones (65.6%). This finding is in agreement with other studies which showed that the more severe the deformity the less likely the correction (Simons, 1985a; Simons, 1985b).

This is further supported by the finding of a residual deformity at operation in 92% of failures. However, it is still difficult to predict which severe foot will or will not respond to this operation based on clinical assessment.

Poor compliance was an important feature of the failed corrections (Bahadur and Bhat, 1989). The reasons for poor compliance were socio-economic in nature as most

of the patients came from poor backgrounds. Bahadur and Bhat and Bahabur 1989) have linked the incidence of severe clubfoot to low socioeconomic status. Sterneberg (1986) also refers to economic problems such as lack of transport money. Seringe (1990) found similar factors.

There are reports in South Africa of the possibility of an intrauterine viral infection affecting the anterior horn cells of the spinal cord (Swart, 1993). Infections are more likely in areas of poor living conditions. This may well explain the impressions of higher proportions of the severe variety of CTEV in several African series (Ickler and Kessi, 1986; Parekh, 1970; Porter, 1992; Workman, 1979).

One complication in a unilateral case was encountered. There were no cases of wound infection. The operation can be considered as a safe one to be undertaken even at district hospital level. It has been stated that the choice of operative procedures should take into account the needs of a particular foot (Cumming and Lovell, 1988). It can be added here that the available expertise in a particular area such as ours must also be considered.

CONCLUSION

From this study the following conclusions can be drawn:-

1. Severe CTEV (clubfoot) is common in Zambia
2. More males than females are affected by severe CTEV
3. The tendons of tibialis posterior and the triceps surae muscles are important tethers in clubfoot.
4. Simple tenotomy of the tibialis posterior and Achilles tendons can correct a high proportion of severe CTEV resisting conservative treatment as long as this is done early.
5. Continued splintage until the child is able to weight-bear is essential.
6. Low socioeconomic conditions are important in the follow-up and possibly the aetiology of CTEV.
7. Tenotomy of tibialis posterior and Achilles tendons is a safe procedure.

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APPENDIX I

SEVERITY OF CLUB FOOT

Mild	-	Can be manipulated into neutral position
Moderate	<	20^0
Severe	>	20^0
Very severe	>	40^0

The degree of deformity applies to equinus, varus or both.

APPENDIX II

TENOTOMY PROFORMA

NAME _____ HOSP NO _____

PRE-OPERATIVE ASSESSORS: 1: _____ 2: _____ 3: _____ DATE _____
 VARUS DEGREES RIGHT _____ degrees LEFT _____ degrees
 EQUINUS DEGREES RIGHT _____ degrees LEFT _____ degrees

MOBILITY: NORMALLY MOBILE R/L RATHER STIFF R/L VERY STIFF R/L
 HEEL CREASE: DEEP R/L MODERATE R/L SLIGHT R/L
 TARSAL CREASE: DEEP R/L MODERATE R/L SLIGHT R/L
 FINAL GRADE: MILD _____ MODERATE _____ SEVERE _____

SIGNATURE _____

OPERATION DATE: _____ SIDE R/L _____
 SURGEONS 1 _____ 2 _____ ANAESTHETIST _____
 INCISIONS: TA vertical/other _____ TP vertical/other _____
 HAEMOSTASIS DIATHERMY/TIES _____ TOURNIQUET RELEASE BEFORE/AFTER
 CLOSURE
 ABNORMAL MUSCLE ANATOMY (as distinct from standard club foot)

TIB POST: EXTENSIBLE _____ POORLY EXTENSIBLE _____ RIGID _____ OTHER _____
 T ACHILL: EXTENSIBLE _____ POORLY EXTENSIBLE _____ RIGID _____ OTHER _____

TENDONS RELEASED/LENGTHENED
 TENDON ACHILLES (TA): TENOTOMISED/LENGTHENED
 TIBIALIS POSTERIOR (TP): TENOTOMISED/LENGTHENED

INTRA-OPERATIVE ASSESSMENT
 GOOD CORRECTION R... RESIDUAL EQUINUS R.... RESIDUAL VARUS R.....
 L..... L..... L.....

CLOSURE
 POST-OP SPLINTAGE _____

POST-OP INSTRUCTIONS: 1. ELEVATE FOOT
 2. WATCH CIRCULATION - if any concern
 then:- THE PLASTER/DRESSING MUST
 BE FULLY RELEASED

POST-OP PROBLEMS _____

At two weeks, manipulation under anaesthetic and repeat POP

MUA @ 2 weeks:

RIGHT: Wound healed YES/NO; infected YES/NO,
 Position obtained; Varus....; equinus....; forefoot adduction.....

LEFT: Wound healed YES/NO; infected YES/NO,
 Position obtained; Varus....; equinus....; forefoot adduction.....

APPENDIX III

FOLLOW UP PROFORMA

NAME HOSPITAL NO.....
 ASSESSMENT AT 6 WEEKS ASSESSORS 1 _____ 2 _____ DATE _____

WOUND HEALED Y/N SEPSIS Y/N
 VARUS DEGREES: RIGHT _____ degrees LEFT _____ degrees
 EQUINUS DEGREES RIGHT _____ degrees LEFT _____ degrees
 GRADE MILD _____ MODERATE _____ SEVERE _____

MOBILITY NORMAL MOBILE R/L RATHER STIFF R/L VERY STIFF R/L
 HEEL CREASE DEEP R/L MODERATE R/L SLIGHT R/L
 TARSAL CREASE DEEP R/L MODERATE R/L SLIGHT R/L

TREATMENT _____

ASSESSMENT AT 3 MONTHS ASSESSORS 1 _____ 2 _____ DATE _____

VARUS DEGREES: RIGHT _____ degrees LEFT _____ degrees
 EQUINUS DEGREES RIGHT _____ degrees LEFT _____ degrees
 GRADE MILD _____ MODERATE _____ SEVERE _____
 MOBILITY AND FUNCTION _____
 COMMENTS _____

TREATMENT _____

ASSESSMENT AT 6 MONTHS ASSESSORS 1 _____ 2 _____ DATE _____

VARUS DEGREES: RIGHT _____ degrees LEFT _____ degrees
 EQUINUS DEGREES RIGHT _____ degrees LEFT _____ degrees
 GRADE MILD _____ MODERATE _____ SEVERE _____
 MOBILITY AND FUNCTION _____
 COMMENTS _____

TREATMENT _____

ASSESSMENT AT 12 MONTHS ASSESSORS 1 _____ 2 _____ DATE _____

VARUS DEGREES: RIGHT _____ degrees LEFT _____ degrees
 EQUINUS DEGREES RIGHT _____ degrees LEFT _____ degrees
 GRADE MILD _____ MODERATE _____ SEVERE _____
 MOBILITY AND FUNCTION _____

COMMENTS _____

TREATMENT _____

FINAL VERDICT _____

APPENDIX IV

CRITERIA FOR SATISFACTORY OUTCOME

(a) Excellent

1. Near normal appearance of the foot.
2. Straight medial border
3. Active eversion of the foot
4. Active dorsiflexion of the toes
5. Plantigrade attitude
6. Pliable and mobile foot joints

A minimal degree of pliable forefoot adduction is considered acceptable in some patients.

(b) Good

A plantigrade foot not meeting all the above criteria.

(c) Poor

Requiring further surgery.