COMPARATIVE STUDY:

PONSETI METHOD VERSUS FRENCH PHYSIOTHERAPY

FOR INITIAL TREATMENT OF IDIOPATHIC CLUB FOOT DEFORMITY

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Abstract

***Background*: Long term complications following extensive surgery for idiopathic clubfoot is a plea for non operative methods of management. The purpose of this study was to compare retrospectively French physiotherapy and Ponseti method used to treat idiopathic clubfoot in 2 institutions.**

***Methods*: 222 idiopathic clubfeet (149 patients) managed during a three years period (2000-2003) were included in this study: 116 clubfeet in group one were treated according to modified French physiotherapy (with percutaneous heel-cord tenotomy in 17%) and 106 clubfeet in group two were treated according to the Ponseti method. The use of further surgery was considered as failure of the non-operative management: complete postero-medial release, partial posterior release, non release limited surgery or non operated feet were noted respectively poor, fair, or scored with the modified Ghanem score.**

***Results* : After a mean follow-up of 5.5 years, similar rate of surgery was performed in both groups (21% in group 1 and 16% in group 2) but complete posteromedial release was mainly done in group 1 (19% of feet), and non release limited surgery was done in group 2 (11% of feet). Results were noted excellent, good, fair and poor in respectively 55%, 20%, 6% and 19% of patients in group 1 and 76%, 17%, 5% and 2% of patients in group 2. Results for Dimeglio grade II clubfeet were not different, but results for grade III and grade IV clubfeet were better in group 2.**

***Conclusions*: Ponseti method enables reduction of extensive surgery compared to French physiotherapy mainly for severe deformities.**

***Level of evidence :* Retrospective comparative study - Level III.**

Key words: Clubfoot/ Comparative study/ Treatment method/ Conservative treatment/ Ponseti/ Functional method/ / Management.

Introduction

The pathogenenesis of clubfoot deformity is still unknown despite numerous studies[1-3]. The management of this deformity continues to be controversial. Many publications have highlighted long term complications following extensive surgery for idiopathic clubfoot: recurrence, overcorrection, stiffness, and pain have been reported after extensive surgery [4-7]. Non-operative or conservative methods of management for clubfoot have gained more importance. Ponseti method [8-11] and French physiotherapy [12-18] are the most popular conservative treatments. Richards et al. compared the two methods after 4.3 years follow-up did not find any difference between French physiotherapy and Ponseti method [19]. Although it was a prospective study, both methods were used in a single center with parent selected treatment. There was cross over between methods and a high rate of relapse and posteromedial release was reported in the Ponseti group.

The purpose of this bicentric study was to compare retrospectively two groups of patients: the first group was treated according to French physiotherapy; the second group was treated according to the Ponseti method strictly applied in a different center. Our hypothesis was that both methods can produce different results, and that the difference could have been influenzed by the grade of severity of the deformity.

Materials and Methods

Inclusion criteria of this retrospective study were consecutive series of idiopathic clubfeet, treated in two institutions during a 3 years period from the first of January 2000 to the 31 December of 2002. Patients managed in the referal institution older than a month after birth was excluded. The severity of clubfeet deformity was graded according to Diméglio/Bensahel score[20] before starting the treatment. Benign feet (grade I) were excluded from the study.

- The French physiotherapy treatment was carried out by a team with large experience in managing clubfoot with such a method. It involved daily gentle mobilization and streching of contracted tissues, stimulation and strengthening of weakened muscles and lastly, taping and splinting to maintain correction. This technique was precise and consisted in a global correction with initial intensive physiotherapy five times a week by a trained physical therapist. No continuous passive motion machine was used in this series. The foot was maintained on a split from femur to foot full time until six month of age. Percutaneous heel-cord tenotomy was performed when lateral X-rays show tibio-calcaneal angle up to 90 ° at 6 months old or in case of plantar convexity appearance at 4 months old [21].

- The Ponseti method was strictly applied according to Ponseti recommendations[10] by the second team by trained staff under the direction of a single surgeon (FC). The experience of this team with this method started in 1999 after the lead surgeon (FC) received formal training from Professor Ignacio Ponseti[11]. Casts were applied at weekly intervals until the adductus and heel varus were corrected. A complete percutaneous heel-cord tenotomy was performed if the foot could not be dorsiflexed to 15° prior to application of the last cast. After the last cast, patient's feet were braced in a derotation splint (Unibar® splint). The derotation splint was used day and night for 4 months and part time night wear until the age of 3 to 4 years. No physiotherapy was provided during the first year of treatment. Recurrences were routinely treated by repeat casting first and the tibialis anterior transfer was performed when there was a persistent, strong, and active supination of the foot.

149 patients with 222 clubfeet in were included in this study (77 patients with 116 clubfeet in group 1 and 72 patients with 106 feet in group 2). Initial characteristics of included clubfeet are summarized in Table 1. All data were comparable in both groups except the age at referral

which was superior in group 1 compared to group 2 patients (10+/- 8 versus 4+/-7 days respectively).

Events as heel-cord tenotomy, new cast series for recurrence, complete or partial surgical releases and limited complementary surgeries were recorded. Feet X-rays with anteroposterior and lateral view were performed at time of revision.

The use of surgery was considered as failure of the non-operative management. Clubfeet operated with complete postero-medial release were noted to be poor results, partial posterior release were noted fair, and clubfeet operated with non release limited surgery or non operated feet were scored with a modified Ghanem and Seringe score on 72 points (Cf. Table 2)[14,15,22]. For the non operated feet, the modified Ghanem scoring system had been used. Certain criteria were removed because as they were inappropriate for young patients at mid term evaluation (patient satisfaction, daily activity, sport, pain) (Table 2). The score on 72 points was converted to a score of 100 points and for a score of up to 90 the result was considered to be excellent; between 81 to 90 it was considered to be good; between 71 to 80 it was considered to be fair and under 70 the result was considered to be poor. Despite the fact that there is no consensus in evaluation of clubfoot management, the Ghanem scoring system is a widely used system in the literature[23].

Statistical analysis

For mean value comparison, adequate tests according to group size (Non parametric test Mann and Whitney, Chi 2 Pearson or Chi 2 corrected of Yates) were used. For qualitative variable comparison, the exact test of Fisher was used. The logiciel BMDP dynamic 7.0 (BMDP Statistical Software Inc., Los Angeles, CA) was used for statistical analysis. The significance level was set at $p<0.05$.

Results

Percutaneous tendoachilles tenotomy was performed in 17% of the feet in group 1, at the mean age of 6 +/- 3 months. During the period of the study the rate of tenotomy increased from 10% (year 2000), to 18% (year 2001) and 24% (year 2002). The tendoachilles tenotomy was performed in 94% of feet in the group 2, at mean age of 5 weeks.

The rate of new series of cast for recurrence was 17% in group 1 and 22 % in group 2; this difference was not statistically significant (Chi 2 of Pearson p= 0.09).

The mean follow-up at revision was 5.5 years for the patients in group 1 and 5.4 years for the patient in group 2. At revision, 21% of feet treated with functional treatment did required surgery. This rate decreased between 2000 and 2002 from 23 to 10%. With the Ponseti method, 16% of feet required surgery.

Figure 1 gives the type of surgery performed in both groups; this was statistically significant (Chi 2 of Pearson p=0.00001). Non release limited surgery was exclusively performed in group 2 (repeat heel-cord tenotomy: 4, transfer tibialis anterior to 3rd cuneiform: 3, and adductor hallucis tenotomy: 2). In group 2, four further feet had isolated botulinum injection to tibialis anterior and/ or hallux adductor.

Final results are shown in figure 2; the rate of excellent results was higher in group 2 and the rate of poor results was lower in this group; this percentage corresponds approximately to the operated feet.

Figure 3 gives the results according to the severity of clubfeet in both groups; in this figure fair and poor results were grouped and qualified as insufficiency results. Results for grade II clubfeet according to Dimeglio were not different between both Ponseti method and French physiotherapy (Chi 2 corrected of Yates p=0.56). Results for grade III and grade IV clubfeet were better after Ponseti method compare to French physiotherapy method (respectively Chi 2 of Pearson p=0.001 and p =0.01).

Discussion

In this comparative study, Ponseti method showed best mid term results as it reduced extensive surgery compared to the French physiotherapy. The difference was noticed in severe and very severe club feet deformities but not in moderate deformities.

Main differences between functional and Ponseti methods of treatment are summarized in Table 3.

Guidelines for the Ponseti method of nonoperative treatment were developed by Dr Ignacio Ponseti in the 1940s and remain essentially unchanged to this day. In contrast to the authors of functional treatment's belief that frequent motion and regular stretching of the rigid clufoot is beneficial, Ponseti believed that these manoeuvres led to inflammatory response with further contraction of the tight tissues. All components of the clubfoot deformity with the exception of the equinus, are corrected simultaneously by abducting the foot under the talus while a counter pressure is applied to the head of the talus. The percutaneous heel-cord tenotomy as a part of the Ponseti method and allows early and quick correction of the deformity with bone or cartilaginous remodelling. Pirani et al. had shown the effect of remodelling during successive casts, not only of the abnormal shape relationships of the tarsal bone, but also of the abnormal shapes of the individual tarsal osteochondral anlages[24]. It is presumed that delayed correction on a foot with non-cartilaginous structures does not allow the same quality of remodelling than when it was performed very early on fast growing tissues.

The Ponseti method had been found to give very reproducible results all over the world [10-11, 25-27]. The method was equally effective when it was directed by a physiotherapist or by a surgeon [28].

Patients from group 2 of the present study were strictly treated according to the author recommendations[10] and results of this group are comparable with litterature with very low rate

of extensive surgery (<5%). In Richards comparative study between french physiotherapy and Ponseti method, a high rate of recurrence (37%) and posteromedial release (16%) was reported in the group treated with Ponseti method[19]. Multiple surgeons (seven) were involved in the Ponseti management in this study and this could have introduced some technical differences which may account for some of the failures. Morever, the abduction brace was maintained at nightime only until the age of two years. It was maintained between the age of three or four years in our group 2 study. This difference in bracing between two studies could have contribuated to the difference in results as the importance of bracing in Ponseti method had been widely highlighted[29]. Another variable in the Richards study was the management of recurrences within 2 years; it was classically treated by 2nd series of Ponseti casting in only half of recurrences. But it was also treated by surgery in 26 feet out of 93 without having performed a 2nd series of casts, and it was changed to French functional method in 22 feet out of 93. This cross over between methods could have been a confusing factor as the philosophy of the Ponseti method was altered. All recurrences in our study group 2 (22%) were systematically treated by 2nd series of Ponseti casting.

The Functional treatment also call French physiotherapy has be described by paul Masse[30] in the 1970s and developped by different centers[12-18,31]. The general philosophy was a very progressive and gradual correction by daily manipulations; various elements of the deformity are corrected separately and in specific order. To the contrary of Ponseti method, wide variety of the results had been reported with French functional treatment[12-18]. The experience, the skill and motivation of the physiotherapist is a major factor for success[12]. This implies the necessity to develop a network of specialized physiotherapists. Althought it was not part of the functional treatment, the percutaneous heel cord tenotomy had been introduced since 1999 [21]. Since the introduction of this procedure, it gained more importance; the rate of

tenotomy of the group 1 children of the present study increased from 10% (year 2000) to 24% (year 2002). Parallel to the increased rate of heel cord percutaneous tenotomy, the rate of extensive release surgery decreased from 23 (year 2000) to 10% (year 2002). Before the introduction of tenotomy, Seringe et al. reported insufficient corrections after functional treatment which required release surgery in 51% of feet with an average follow-up of 6 years[12]. In the group I of the present series, treated by the same team, and after a similar follow-up (5.5 years mean follow-up), only 21% of feet required release surgery. This could be attributed to the use of percutaneous heel-cord tenotomy.

This procedure facilitated the correction, minimized the risk of rocker-bottom deformity and perhaps flatenning of the talus convexity. Early complications after heel-cord tenotomy have been reported [32-34] but no study has focused on the impact of tenotomy on the strength of gastrocnemius-soleus muscle. In functional treatment a very rational use of percutaneous tenotomy is done in order to avoid the aggravation of the gastrocnemius-soleus muscle strength insufficiency due to the clubfeet [21].

El-Hawary et al. compared function during gait analysis of patients treated non-operatively with functional treatment and Ponseti method [35]. The rate of normal kinematic ankle motion in the sagittal plane was found better after functional treatment (65%) compared to Ponseti method (45%). Gait abnormalities that were seen in group treated with functional treatment were characterized by mild equinus (15%) and/or footdrop (19% of the feet). In contrary, main gait abnormalities reported after Ponseti method was excessive stance-phase dorsiflexion (48% of the feet) and a calcaneus gait (10%). Authors concluded that the difference between both methods may, in part, be the result of the percutaneous heel-cord tenotomy that was performed as part of the Ponseti cast technique but not as part of the physical therapy program in this series. This assesment was performed in patients with an average of two years and three months of age; this could explain the high rate of stance-phase

dorsiflexion in patients of the Ponseti group. The same assesment with longer follow-up may provide a different conclusion as the passive range of dorsiflexion decreases usually with time during the Ponseti mangement.

In the study by Richards and al.[19], French physiotherapy was performed with a higher rate of heel-cord tenotomy (32 %) and was performed earlier than the present study (17%). During the Ponseti treatment, the rate of heel-cord tenotomy was lower (73%) compared to the present study (94%). These diffrence in management between Richards study and the present study could explain the difference in results.

Difference in results can either be due to the variations in the treatment methods or the evaluation methods. In the Richards study, the result was apreciated according to the surgery performed[19]. The criteria of surgical indication was reasonable in a single center study but can be a limiting factor in multicenter studies as criteria for surgery can vary between teams.

It is reasonable to consider that release surgery as failure of non-operative treatment even if short and mid-term results after these procedures can be very good. Long term studies of operated feet are less optimistic[4-7]. But it is important to consider that limited posterior release is similar to tibialis anterior transfer. A distal tendon transfer generates fewer scars than a posterior release surgery and could be associated with less stiffness and better outcome. In the present study, release surgery was systematically scored poor or fair, but for all other patients, the modified Ghanem and Seringe score (on 72 pts) was used and patients evaluated in excellent, good, fair or poor. A plantigrade foot achieved with or without tenotomy should not systematically graded good.

Of course, the present study had several limitations as it was a retrospective analysis, patient evaluation was performed by each team without cross evaluation. Surgical indications varied

with the teams. Despite the decreased indications for complete posteromedial release, this surgery is still the standard procedure for unsatisfactory corrections after functional treatment. In the Ponseti method of clubfoot management the philosophy is less aggressive surgery tolerating minor imperfections.

The short follow-up of this study is another limitation; it doesn't allow an accurate evaluation the gastrocnemius-soleus muscular complex and all patients of this study will need to be reevaluated after skeletal maturity. However the result assessment is acceptable as late recurrences after the age of 5 years are rare in idiopathic clubfeet [36]. The similar follow-up with Richards's paper makes comparison possible between both studies.

Conclusion

Both French functional treatment and Ponseti method allow reducing the need of complete release surgery. Results for grade II clubfeet were not different between both groups but results for grade III and grade IV clubfeet were better after Ponseti method compared to the French physiotherapy method. This study could suggest increasing the rate of heel-cord tenotomy during French Physiotherapy method but further evaluation of both groups will need to be conducted in order to consider the impact of heel-cord tenotomy on gastrocnemius-soleus muscle strength.

Figures and tables legends

	Group 1 (FP)	Group 2 (Ponseti)	Significance
Number of feet	116	106	
Number of patients	77	72	
Age at referral in the institution (days)	10 +/- 8	4 +/- 7	p<0.00001
Sex / Boys %	65 %	73%	p= 0.20
Side / Right %	52 %	55 %	p= 0.62
Affected foot / bilateral %	50 %	47 %	p= 0.79
Diméglio grade	Grade II: 21 % Grade III: 52 % Grade IV: 27 %	Grade II: 10 % Grade III: 56 % Grade IV: 34 %	p=0.10

Table 1. Initial data of both the groups. Both groups were comparable except for the age at referral in the institution (p<0.00001).

French Physiotherapy	Ponseti method
Sequential mobilization	Global correction
Progressive correction	As quick as possible correction
Late heel-cord tenotomy if necessary	Early cord tenotomy nearly systematic
Physiotherapy 5 times a week / first year	No physiotherapy
Concept of tibialis anterior lengthening	Concept of tibialis anterior transfer

Table 3. Comparaison between both conservative methods philosophy.

Morphology	Forefoot	Adduction	≥ 20°	-4
			≥ 5° and < 20°	-2
			≥ -10°	-2
			Dynamic toes adduction	-1
		Cavus	Medial arch slightly cavus	-1
			Medial arch with important cavus	-2
			Flat foot	-1
			Convex with overcorrection	-2
		Supination	Very important, irreducible, or dorsal bunion	-4
			Moderate (reducible until 0°of pronation)	-2
			Slight (reducible beyond 0° of pronation)	-1
	Hindfoot		Varus > 5°	-6
			Varus ≤ 5°	-4
			Neutral	-2
			Slight valgus superior to physiologic valgus	-2
			Valgus > 10° (overcorrection)	-6
			Important translation of the foot laterally to the leg	-10
	Global adduction		>0 and ≤ 10°	-1
			<10 and ≤ 25°	-2
			> 25 and ≤ 40°	-3
			> 40°	-4
	Shoes	Special shoes		-4
		Normal shoes but more than 3 sizes of difference between the 2 feet		-2
	Scare		Unaesthetic	-2
	X-ray	TCD	< 15° (anteroposterior view)	-1
			< 15° (lateral view)	-1
		Talar dome	Slightly flat	-1
			Very flat (square talus)	-2
		Talonavicular subluxation	< 1/3 height	-2
			< 1/3 height + cuneiformisation	-3
			> 1/3 height	-4
			> 1/3 height + cuneiformisation	-6
Function	Passive	Dorsal flexion	< -10°	-8
			< 0° and ≥ -10°	-4
			≥ 0° and < 10°	-2
		Plantar flexion	< 10° (with DF> 25°)	-8
			≥ 10° and < 30°	-4
			≥ 30° and < 40°	-2
		Subtalar joint	Completely stiff	-4
			Moderately stiff	-2
	Active	Triceps sural	Walk on tip-toes impossible	-12
			Walk on tip-toes possible monopodal jump impossible	-8
			Monopodal jump possible but difficult	-4
Total				-72

Table 2. Modified Ghanem and Seringe Global score: 72 points. According to the original score out of 100 pts, some criteria had been excluded (non measurable in young children: patient satisfaction, daily activity, sport, and pain).

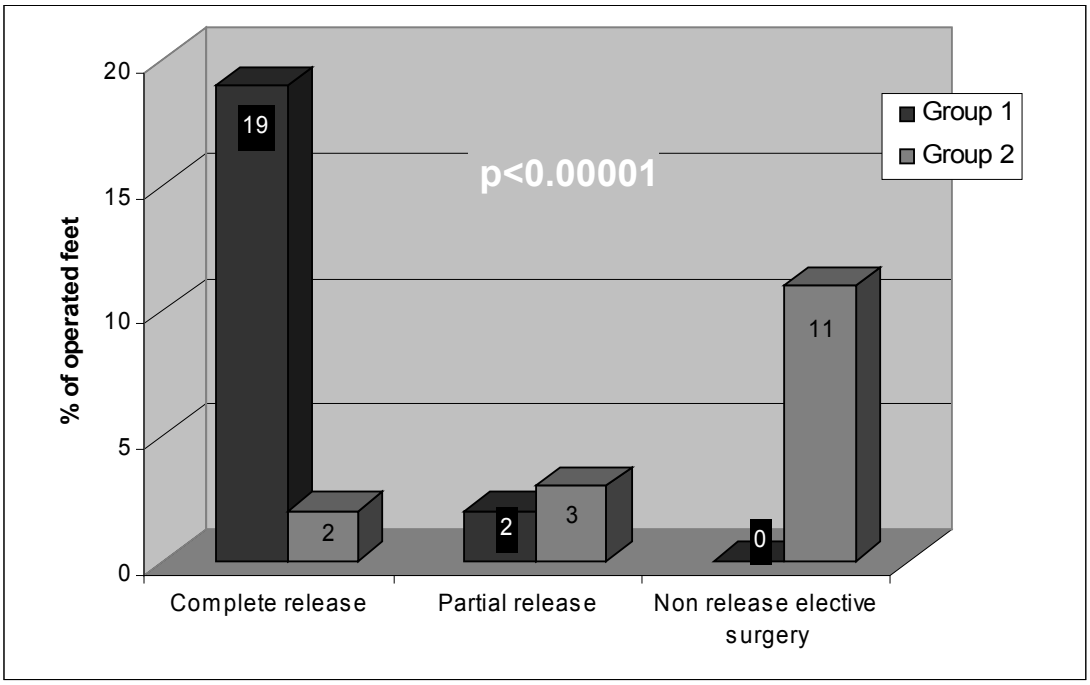

Figure 1. Surgery performed during French physiotherapy treatment applied in Group 1 and Ponseti method applied in Group 2. The type of surgery was different between groups.

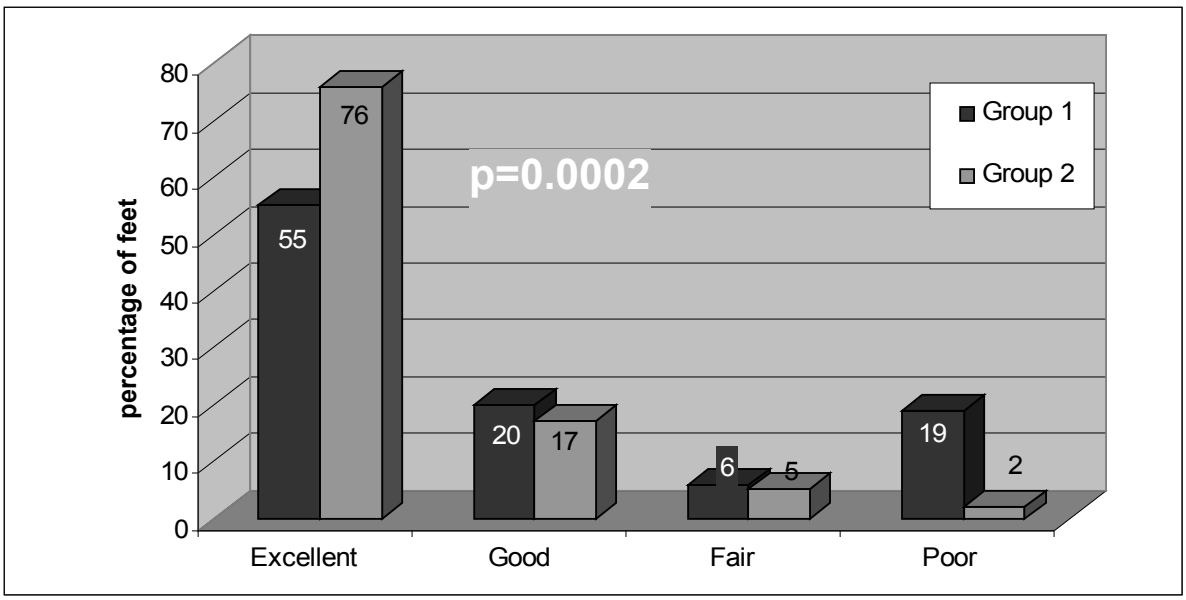

Figure 2. Comparative results at time of revision between French physiotherapy method applied in Group 1and Ponseti method in Group 2.

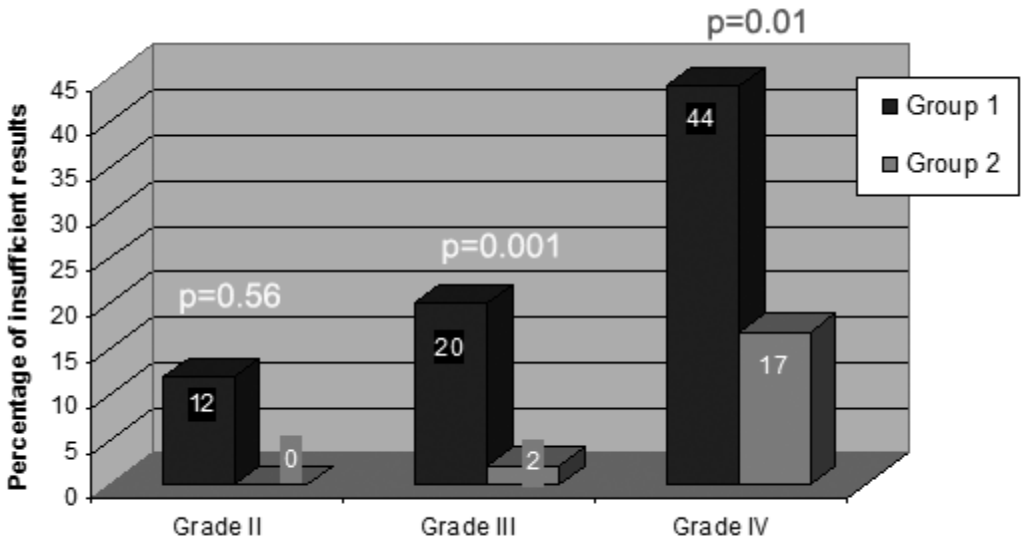

Figure 3. Comparison of unsatisfactory results (fair and poor together) in both groups at time of revision according to initial severity of the deformity (Diméglio grade).

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